



Convergence of Income Inequality in OECD Countries Since 1870: A Multi-Method Approach with Structural Changes

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Abstract

This paper aims to examine convergence of income inequality in 21 OECD countries using several empirical techniques. In particular, we have used a new panel stationarity test, which allows for structural changes and cross-sectional dependence to examine the stochastic convergence of income inequality. We also employed a time series approach, residual augmented least squares-Lagrange multiplier unit root test. The empirical results show evidence for absolute, conditional, and sigma convergence. The conditional convergence test results suggest that countries are converging, but conditional on the two structural factors-economic and population growth. The stochastic convergence test results indicate the existence of convergence at the country-specific level. The results further confirm the existence of convergent clubs among OECD countries.

Keywords Income inequality · Gini index · Convergence analysis · Structural changes

1 Introduction

One of the main macroeconomic goals of countries is to increase their income levels. Countries want to reach the prosperity level of richer countries by introducing various activities that allow economic growth to be faster than in richer countries. In this context, convergence means that the originally poor economies catch up with initially rich economies (Quah, 1996). The economic convergence hypothesis was first analyzed in terms of physical capital accumulation (see, e.g., Barro & Sala-i Martin, 1992). The impact of

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physical capital on countries' economic growth has been used to try to determine the extent to which a poor country can converge to a rich country.

The neoclassical growth models developed by Solow (1956) and Swan (1956) assume that income gap across countries decreases over time due to diminishing returns to capital (Ivanovski et al., 2020). Neoclassical growth models account for income convergence, which is triggered in the neoclassical growth model by capital moving from high-income economies, where it is abundant to low-income economies, where it is scarce to earn the higher returns (Buckle & Cruickshank, 2007). However, Benabou (1996) indicates that countries with similar fundamentals tend to have the same invariant distributions of wealth and income before taxes. This case implies that neoclassical growth models account not only for income convergence but also for inequality convergence, also known as distributional convergence. In particular, income inequality convergence suggests that regions/countries with similar bases move toward the same constant income distribution, with inequality rising (falling) in countries with low (high) initial inequality (Lin & Huang, 2011).

Along with income, income inequality also plays an essential role in convergence, because when individuals search for better jobs, they are likely to seek out not only high-income regions, but also those with low-income inequality (Tselios, 2009). Apart from income itself, the distribution of income across regions or individuals affects many objectives of interest to policymakers, such as regional development, geographic redistribution, and comparative economic performance. Therefore, the cross-national convergence of income inequality is an important research topic.

Quah (1996) argues that for convergence between countries, two things must occur simultaneously. i) The poor country should increase its level of output and income and catch up with the rich country (growth mechanism). (ii) The inequality in income distribution between countries should be closed (convergence mechanism). Economic convergence is achieved when these two mechanisms work. However, these two processes are independent, and a causal relationship between the processes should not be sought (Mendoza-Velázquez et al., 2020).

Countries/regions reach steady state when they reach a certain level in terms of macro-economic indicators such as interest rate, labor force, capital stock, and population growth rate. After this steady-state point, economic growth takes place at a constant rate. As the growth rates of rich countries remain stable and the growth rates of poor countries are relatively faster, convergence between countries and thus a decrease in income inequality can be expected. As inequality decreases in countries with high inequality, it may increase in countries with low inequality, so that countries with similar fundamentals to move closer to a common distribution (Ravallion, 2003).

Income inequality has grown, especially in the wake of globalization. Rising income inequality is among the world's most important political problems, and persistently high inequality can lead to instability (Chambers & Dhongde, 2016). Dreher and Gaston (2008) emphasized that income inequality increased in the 30 years between 1970 and 2000 in OECD countries. For this reason, we seek to answer whether income inequality is convergent across OECD member countries using convergence approaches.

There are several approaches to measuring convergence. We mainly focus on absolute, sigma, conditional, stochastic, and club convergence. Absolute convergence means the elimination of income inequality in the long run. Mankiw et al. (1992) explained the impact of initial conditions of factors such as physical and human capital on the convergence of income inequality with conditional convergence. This type of convergence states that income inequality partially decreases but does not completely disappear in the long-run. Moreover, sigma convergence demonstrates that the dispersion of

income levels disappears over time (Bahmani-Oskooee et al., 2016). Stochastic convergence implies stationarity of relative income inequality series. Club convergence does not rely on any preliminary assumptions about the stationarity and heterogeneous transition dynamics of the series and allows for multiple equilibria (Mendoza-Velázquez et al., 2020).

In this study, we analyze the convergence of income inequality in 21 OECD member countries. Our study differs from previous attempts in several aspects. i) The study analyzes income inequality for OECD countries using annual time series data for the period 1870–2018. To the best of our knowledge, no study has analyzed the convergence of income inequality over a period of about 150 years. Influential observations in time series contain more information about the series and can provide more robust conclusions. In this context, our study aims to present the most accurate results for inequality convergence across OECD countries. ii) In this study, we test the convergence of income inequality across OECD member countries using beta, sigma, stochastic, and club convergence techniques. In this way, we aim to provide, for the first time, comprehensive information on the convergence of inequality across OECD member countries and share insights that, in light of this information, lead to common policy implications in the fight against income inequality.

We expect the study to stand out from the existing literature on these two points and make an important contribution. iii) Unlike previous studies, we have employed panel stationarity tests of Nazlioglu et al. (2021), which allows for cross-sectional dependence and structural shifts, to examine the stochastic convergence of income inequality. There is a need to consider structural shifts because several events have occurred in the last 150 years (e.g., world wars, recessions, and oil crises) that have structurally changed the macroeconomic series of several countries, including income inequality. There is also a need to provide for cross-sectional dependence, as Hadri and Kurozumi (2011) have shown that panel data are profoundly distorted when the assumption of cross-sectional independence is violated. The new panel stationarity tests have also been shown to possess superior size properties than the group-mean tests (Nazlioglu et al., 2021).

OECD countries are the focus of this paper for numerous reasons. Income inequality in many OECD members is at its highest point for the last 50 years. The top 10% of the income group possesses about half of all wealth, while only 3% of total wealth is owned by the bottom 40% of the income group (OECD, 2019). Moreover, the average income of the richest 10% in OECD countries is about 10 times that of the poorest 10%, compared to seven times about 25 years ago. Consequently, OECD nations have also acknowledged that a substantial section of their populations face economic insecurity. The cost of the average lifestyle of the middle-class has risen faster than inflation. Besides, housing costs in these countries have risen faster than median household income. About 30% of households are economically insecure, signifying they do not have enough liquid financial resources to sustain their living standard at poverty levels for at least three months (OECD, 2019). Not surprisingly, reduction of inequality both among and within countries is one of 17 Sustainable Development Goals of the 2030 Agenda.

The other parts of the paper are as follows. The next section discusses the limited number of studies that have analyzed the convergence of income inequality. After the data and methodology section, the empirical results section presents the results of the study. The last two sections of the study consist of a discussion of the results and a conclusion. In these sections, the findings are discussed, and policy recommendations are made.

2 Literature Review

Many researchers have studied income convergence from the past to the present and made policy recommendations accordingly. Some of these researchers found that income convergence is valid (Bahmani-Oskooee et al., 2016; Furuoka, 2019), while others stated that differences in countries' economic growth would increase over time (Li et al., 2016; Yaya et al., 2020). There are many studies on income convergence, but few studies have examined income inequality convergence (Chambers & Dhongde, 2016; Tselios, 2009). Similarly, Arcabic et al. (2021) emphasize that income inequality convergence has not been thoroughly studied in the literature.

Benabou (1996) was the first to analyze and found evidence of convergence in income inequality using regression analyses for 30 countries between 1970 and 1990. In a later paper, Marina (2000) found that Argentine provinces tended to converge to the same level of inequality using a regression analysis for the period 1953–1992. Panizza (2001) substantiated the income inequality convergence for the US states using ordinary least squares (OLS) and generalized methods of moments. Bleaney and Nishiyama (2003) employed a regression for 79 nations over the period 1965–1990 and concluded that convergence of income inequality is much faster in developed OECD countries than in developing countries. Ravallion (2003) used OLS and instrumental variable approaches for 66 countries and concluded that income inequality gap has been slowly declining since the 1980s. Goerlich and Mas (2004) used regression analysis and confirmed an absolute convergence in income inequality for Spanish provinces from 1973 to 1991. Ezcurra and Pascual (2005) used a stochastic kernel approach from 1993 to 1998 and confirmed the validity of inequality convergence in European Union countries.

Moreover, Kakamu and Fukushima (2005) focused on Atkinson's (1970) inequality measure for Japan from 1986 to 1999. They found that despite the rise in individual income inequality in the 1990s, there was a decrease in regional inequality. Yildirim and Ocal (2006) used beta convergence regressions for Turkey from 1979 to 2001 and concluded that there is convergence in income inequality at the national level. Gomes (2007) applied the least absolute deviation and OLS to the two periods, 1991 and 2000, and verified the inequality convergence for 5507 Brazilian municipalities. Tselios (2009) utilized panel data growth models for 102 regions of the European Union from 1995 to 2000 and found conditional convergence in income while there is unconditional convergence in inequality. Lin and Huang (2011) conducted a novel OLS method for the 48 US states from 1916 to 2005 and found robust evidence of convergence in income inequality across regions, indicators, and time. Lin and Huang (2012) also used the panel Lagrange multiplier (LM) unit root test and obtained the same findings for the same period. Alvaredo and Gasparini (2015) utilized OLS and IVA methods for 76 countries from 1981 to 2010 and supported the inequality convergence.

More recently, Chambers and Dhongde (2016) tested inequality convergence among 81 nations from 1990 to 2010 using panel regression models and verified convergence in income inequality. The authors also noted that the convergence speed of inequality is greater in developed countries than in developing countries. Tian et al. (2016) utilized the club convergence test for China and identified two convergent clubs; one is high, and the other is a low-income club. The authors also emphasized that club has an association with population, human capital, and investment. Mendoza-Velázquez et al. (2019) utilized various unit root tests and noted that income inequality converged in 22 out of 32 Mexican states. Ivanovski et al. (2020) performed a residual augmented least squares (RALS)

unit root test to investigate the inequality convergence among Australian territories and states from 1942 to 2013. The findings of the study showed that income inequality is converged to the steady state in various states except for Victoria, and that this situation is sensitive to structural breaks. Mendoza-Velázquez et al. (2020) applied various time series approaches and found that income inequality in Mexican states does not converge in the long run. However, the researchers noted that there is club convergence for regional inequality. Arcabic et al. (2021) used OLS, the log t-convergence test, and spatial autoregressive estimation to analyze inequality convergence in the US states from 1917 to 2012. The study results show that the convergence of inequality in the US is weak, the convergence covers only the period 1932–1985, and the inequality diverges in the other periods. Table 1 summarizes the findings of the studies in detail according to the convergence distinctions.

In examining the literature, we find that studies generally support convergence in income inequality. Most studies have been conducted for the US states and European Union countries. The only study that focuses on OECD member countries is Bleaney and Nishiyama (2003). This study was carried out with traditional regression analysis and covered a period of only about 25 years. In this respect, there is a gap in the literature. We attempt to fill this gap by analyzing 150 years using current time series techniques and different convergence approaches. We also make the first attempt to explore the convergence of income inequality with Fourier functions. From 1870 to 2018, there were World War I and World War II, two major economic crises such as 1929 and 2008, and many other similar events. These events are structural changes that affect the income distribution of countries, and ignoring them leads to wrong conclusions. Fourier functions allow us to capture a large number of smooth structural changes with unknown timing and structure in the series and thus obtain more robust results on the convergence of income inequality. We aim to contribute to the current literature with these aspects of our study.

3 Data and Methodology

3.1 Data

Given the limited data on income inequality, we investigated the convergence of income inequality across the 21 countries¹ by using the data period of data from 1870 to 2018. We used the Gini index as an indicator of income inequality and compiled data from The Standardized World Income Inequality Database (2021) prepared by Solt (2020) and the World Bank (2022). The data for the population has been derived from Maddison Project Database 2020 (Bolt & van Zanden, 2020). The data for per capita real gross domestic product for Japan (1870–2016) have been generated from Maddison Project Database 2018 (Bolt & van Zanden, 2020), while data for per capita real gross domestic product for Ireland (1870–1920) has been collected from Madsen and Ang (2016). The remaining per capita real gross domestic product data (2011-dollar prices) for these two countries and the full per capita real gross domestic product data (2011-dollar prices) for the other 18 countries have been collected from Maddison Project Database 2020 (Bolt & van Zanden, 2020). The real gross domestic product data for Japan (1870–2016) and Ireland (1870–1920) has been rescaled so as to be consistent with the remaining real gross domestic product data.

¹ The list of countries is shown in the Table 1.

Table 1 Existing studies on income inequality convergence

Panel (a)	Sample/period	Methodology	Convergence
<i>Panel (a): beta convergence</i>			
Panizza (2001)	48 US States	OLS, generalized methods of moments	Beta convergence ✓
Bleaney and Nishiyama (2003)	79 countries/1965–1990	Regression analysis	Beta convergence ✓
Ravallion (2003)	66 countries	OLS	Beta convergence ✓
Yildirim and Ocal (2006)	Turkey/1979–2001	Regression analysis	Beta convergence ✓
Alvaredo and Gasparini (2015)	76 countries/1981–2010	OLS and IVA	Beta convergence ✓
Chambers and Dhongde (2016)	81 nations/1990–2010	Panel regression	Beta convergence ✓
Arcabic et al. (2021)	US states/1917–2012	OLS, log t-convergence test	Beta convergence X
<i>Panel (b): conditional convergence</i>			
Benabou (1996)	30 countries/1970–1990	Regression analysis	Unconditional convergence ✓
Tselios (2009)	102 regions of the European union/1995–2000	Panel data	Unconditional convergence ✓
<i>Panel (c): regional convergence</i>			
Ezcurra and Pascual (2005)	European union countries/1993–1998	Stochastic kernel approach	Regional convergence ✓
Kakamu and Fukushima (2005)	Japan/1986–1999	Atkinson's inequality measure	Regional convergence ✓
Gomes (2007)	5507 Brazilian municipalities/1991 and 2000	Least absolute deviation approach and OLS	Regional convergence ✓
<i>Panel (d): absolute convergence</i>			
Marina (2000)	Argentina/1953–1992	Regression analysis	Absolute, Beta, and conditional convergence ✓
Goerlich and Mas (2004)	Spain/1973–1991	Regression analysis	Absolute convergence ✓
<i>Panel (e): club convergence</i>			
Tian et al. (2016)	31 Chinese provinces 1978–2013/	Phillips and Sul convergence analysis	Club, beta, and sigma convergence ✓
Mendoza-Velázquez et al. (2020)	Mexico/1940–2015	Phillips and Sul convergence analysis	Club convergence ✓
<i>Panel (f): sigma convergence</i>			
Lin and Huang (2011)	48 US states/1916–2005	A novel OLS	Sigma convergence ✓

Table 1 (continued)

Panel (a)			
Author(s)	Sample/period	Methodology	Convergence
<i>Panel (g): stochastic convergence</i>			
Lin and Huang (2012)	48 US states/1916–2005	Panel LM unit root test	Stochastic convergence ✓
Mendoza-Velázquez et al. (2019)	32 Mexican states/1940–2010	Kapetanios unit root test	Stochastic convergence ✓ for 22 of 32 Mexican states
Ivanovski et al. (2020)	Australia/1942–2013	RALS unit root test	Stochastic convergence ✓

✓ and X denote validity and invalidity, respectively

Table 2 Descriptive statistics

Country	Mean	Median	Max	Min	Std	Skewness
Australia	−0.058	−0.097	0.238	−0.219	0.120	0.452
Austria	−0.082	−0.087	0.103	−0.196	0.042	1.663
Belgium	−0.184	−0.197	−0.061	−0.292	0.048	0.577
Canada	−0.064	−0.065	0.083	−0.270	0.088	0.116
Denmark	−0.084	−0.087	0.233	−0.292	0.102	0.261
Finland	0.174	0.256	0.676	−0.341	0.297	−0.243
France	0.017	−0.015	0.215	−0.093	0.070	0.977
Germany	−0.086	−0.095	0.011	−0.191	0.042	0.333
Greece	0.052	0.004	0.252	−0.097	0.090	0.481
Ireland	0.044	0.025	0.253	−0.167	0.077	0.829
Italy	0.133	0.137	0.235	−0.080	0.065	−0.624
Japan	−0.002	0.007	0.205	−0.158	0.075	0.067
Netherlands	0.203	0.309	0.581	−0.248	0.252	−0.245
New Zealand	0.016	−0.010	0.175	−0.196	0.066	0.100
Norway	−0.149	−0.155	−0.002	−0.323	0.073	−0.188
Portugal	−0.133	−0.14	0.206	−0.417	0.177	0.383
Spain	−0.230	−0.424	0.200	−0.525	0.263	0.464
Sweden	−0.045	0.007	0.230	−0.307	0.155	−0.074
Switzerland	0.193	0.137	0.426	−0.101	0.187	0.056
United Kingdom	−0.079	−0.133	0.188	−0.237	0.132	0.891
United States	−0.005	−0.080	0.246	−0.175	0.140	0.765

The series are in logarithmic forms

We have listed the descriptive statistics in Table 2. Finland has a maximum value of the Gini index of 0.676, while Belgium has a minimum value of the Gini index of −0.061. The Netherlands has the highest mean level of the Gini index in the historical process of 0.203. Furthermore, if symmetrical distribution properties of the Gini data are reviewed, one can infer that the number of positive skewness values is higher than the negative ones. It can be said that the Gini data are either somewhat or moderately skewed, except in Austria. Austria has the most positively skewed distributional characteristics compared to the other panel members.

3.2 Methodology

3.2.1 Beta Convergence

To compute conditional convergence or beta convergence, we employed the method of Marrero et al. (2021). This method requires a neoclassical growth regression specification for income inequality. The change in income inequality is specified as in Eq. (1):

$$\Delta GINI_{it} = \alpha + \beta GINI_{it-1} + \delta Z_{it} + \varepsilon_{it}, \quad (1)$$

where β is the convergence term. A negative β indicates that the so-called beta convergence is present and OECD nations with comparatively high (low) initial income inequality levels

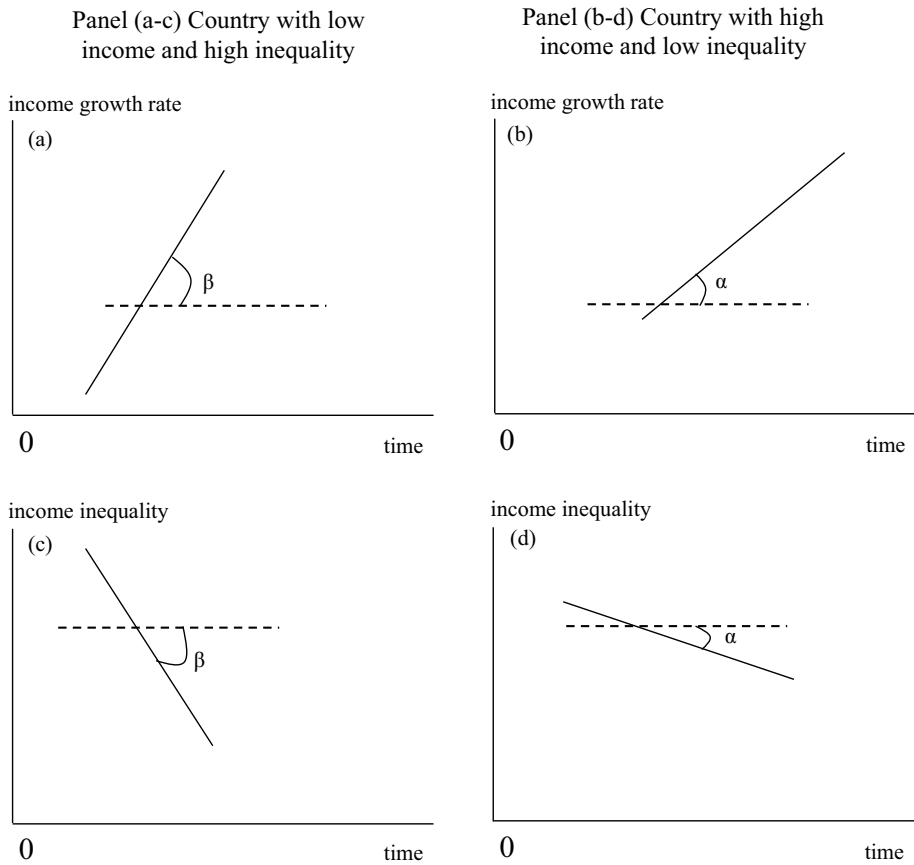


Fig. 1 Convergence in income per capita and income inequality. *Source:* Tselios, 2009

will catch up with the OECD nations with initially low (high) levels if they are projecting toward a similar level of income inequality. Absolute beta convergence analysis is conducted when factors that might affect the convergence of income inequality are not included in the study. The absolute beta convergence suggests that countries converge to the same steady state. However, the absolute convergence results may be biased because they do not account for the role of other variables. Therefore, we also analyzed conditional beta convergence, which suggests that nations experience beta convergence but dependent on their structural characteristics, including economic and population growth. In such a scenario, each nation converges to its own steady-state. These countries cannot converge to a similar level unless they have identical structural factors (Marrero et al., 2021). Z is a vector that houses contributors to the convergence of income inequality, including economic and population growth rate. Beta convergence can also be explained by graphical analysis. For convergence to occur, income and inequality in a high-income country and a low-income country may change over time, as shown in Fig. 1:

Figure 1 deals with panels (c) and (d) because they involve income inequality. According to Tselios (2009), in panel (d), income inequality can increase in a country with low inequality, and the curve can also be positively sloped. Either way, $\beta > \alpha$. In the figure, we

can see that the rate of decline in inequality is significantly higher in the country with high-income inequality than in the country with low inequality, and thus convergence between the two countries can be achieved. In his study, Kuznets (1955) actually implies a convergence of income inequality. This is because, according to the Kuznets curve, income inequality increases in developing countries with low inequality, and in developing countries that have reached the threshold, income inequality starts to decrease after a certain point. For this reason, there may be a convergence of income inequality, and the inequality gap between high-income and low-income countries may narrow over time.

3.2.2 Sigma Convergence

Sigma convergence is based on a series dispersion, and it is assumed that the reduction in the dispersion within a series over a specific time period indicates that convergence exists. Friedman (1992) suggested that convergence should be assessed directly by evaluating the trend of dispersion of a series across countries instead of examining the presence of convergence indirectly via beta convergence. We follow the paper of Mohammadi and Ram (2017) that regressed trend on the standard deviation of income inequality in this paper as in Eq. (2):

$$\sigma_t = \alpha_1 + \alpha_2 T + \varepsilon_t, \quad (2)$$

where σ is the standard deviation of income inequality, T is the linear trend. There is empirical support for sigma convergence if the linear time trend coefficient is negative as well as significant.

3.2.3 Stochastic Convergence

3.2.3.1 Modelling Strategy We adopt the methodology of Carlino and Mills (1993) to have deep insights into the country-specific movement of income inequality and estimated relative income inequality of countries by the following specification:

$$GINI_{it} / \overline{GINI}_t, \quad (3)$$

In Eq. (3), $GINI_{it}$ represents Gini index of the country of i at t th time, while $\overline{GINI}_t$ denotes average Gini index of countries at t th period. We converted all Gini data into logarithmic terms. The primary purpose of the estimation of the relative income inequality of the panel member is to observe how country i deviates at the t year from the average of the sample as follows: $Relative\ Income\ Inequality_{it} = \ln(GINI_{it}) - \ln(Average\ GINI_t)$.

3.2.3.2 Panel Stationarity and Unit Root Tests The cross-sectional dependence (CSD), which is common in panel data, could generate biased estimates in panel stationarity/unit root, cointegration, and causality analyses. Therefore, a preliminary analysis must be conducted to detect whether CSD exists. Consequently, we investigated the existence of cross-section dependence by utilizing LM-based bias-adjusted CSD test proposed by Pesaran et al. (2008).

We examined the stationarity properties of the income inequality data by applying the second generation panel stationarity tests. To this end, we applied the panel stationarity test of Bai and Ng (2005), which assumes the nonexistence of structural shifts, and the stationarity test of Carrion-i-Silvestre et al. (2005), which assumes the existence of sharp

structural changes. We also utilized the panel stationarity test of Nazlioglu and Karul (2017) to account for smooth structural shifts and CSD in the analysis, and a unit root test by simply adopting the RALS estimation procedure, which integrates the LM unit root method of Lee et al. (2012) and the RALS method of Im et al. (2014). The RALS-LM method enables us to endogenously determine break dates and provides consistent estimations in the case of non-normality of the errors (Churchill et al., 2020).²

In addition, we employed the Fourier PANIC approach assuming the existence of gradual shifts and allowing for CSD by adopting the principal component-based factor modeling strategy and combination of p -values suggested by Nazlioglu et al. (2021). Employing a set of traditional stationarity tests with and without structural shifts and unit root tests with structural breaks enables us to perform comparative analysis under different scenarios, helps avoid biased hypothesis testing and inference, and provides deep insight into the nature of the data. Besides, Enders and Lee (2012) showed that the number of smooth and gradual shifts in the economic series may be more frequent compared to the sharp ones. Therefore, using the panel stationarity method with smooth shifts allows us to model structural changes in smooth form, capture nonlinearities in the data, and serves to better reflect long-term fluctuations in the data. In addition, it is not necessary to exogenously determine the number of structural changes. Using methods that follow different strategies, such as factor modeling and principal component approaches, we can better capture the factors that lead to CSD (Erdogan et al., 2020). Therefore, we employed a panel stationarity test with smooth shift (Nazlioglu & Karul, 2017) and recently proposed the Fourier- PANIC method (Nazlioglu et al., 2021). The data generation process of the newly developed Fourier- PANIC test can be described as in Eq. (4):

$$Y_{it} = \alpha_i(t) + r_{it} + e_{it} \quad (4)$$

$$e_{it} = \lambda_i F_t + \varepsilon_{it}$$

where r_{it} can be defined as $r_{it} = r_{it-1} + v_{it}$ ($i = 1, \dots, n, t = 1, \dots, T$). Y_{it} denotes relative Gini index while r_{it} shows a random walk process. F_t represents unobserved common factor and is typically not known. Moreover, $\alpha_i(t)$ it denotes a time-independent deterministic term, and any structural change is modeled by using the Fourier approximation. The level shift, and the level and trend shift models of the Fourier PANIC method can be shown as in Eqs. (5) and (6), respectively:

$$\alpha(t) = (1, \sin(2\pi kt/T), \cos(2\pi kt/T))', \quad (5)$$

$$\alpha(t) = (1, t, \sin(2\pi kt/T), \cos(2\pi kt/T))', \quad (6)$$

where k represents Fourier frequency. Nazlioglu et al. (2021) propose three type Fisher statistics: $P(k)$, $P_m(k)$ and $Z(k)$. P can be estimated as $P = -2 \sum_{i=1}^N \ln(p_i) \sim \chi_{2N}^2$. $P_m(k)$ is a modified version of the P_m statistic of Choi (2001), where P_m can be defined as $P_m = (P - 2N) / \sqrt{4N} \sim N(0, 1)$. Zk is the inverse normal test of Choi (2001), where Z statistic can be obtained as $Z = 1 / \sqrt{N} \sum_{i=1}^N \phi^{-1}(p_i) \sim N(0, 1)$. ϕ is the standard normal

² Due to being widely used in economic literature, theoretical background of the CSD and panel stationarity and RALS-LM tests apart from newly developed test by Nazlioglu et al. (2021) were not explained.

cumulative distribution function. Nazlioglu et al. (2021) propose utilizing the boundary rule of Sul et al. (2005) to estimate long-run variance with the Bartlett kernel. They adopt the response surface function and use internal estimates to obtain the p -values.

3.2.4 Club Convergence

We also use the log- t approach developed by Phillips and Sul (2007, 2009) to test for club convergence. Phillips and Sul (2007, 2009) simply adopt the following model in Eq. (7) to begin the analysis:

$$Y_{it} = \delta_{it}\psi_t, \quad (7)$$

where δ_{it} and ψ_t denotes time-varying elements. ψ_t represents the total common evolution of Y_{it} . δ_{it} shows time-varying idiosyncratic part denoting the deviation of a series i from a common path, which is decided by the magnitude of ψ_t . The whole members or a subgroup of the panel will be convergent to its steady-state path provided $\lim_{p \rightarrow \infty} \delta_{it+p} = \delta$ for all i , regardless of the distance of the series from the steady-state. The club convergence method is premised on the mean of the gap between δ_{it} and δ decreases up to a rate proportionate to $1/(t^\zeta(\log(t+1)))$ for $\zeta \geq 0$ and $\delta_{it} = \delta$ for every i . To obtain δ_{it} , Phillips and Sul (2007) rescale Eq. (7) by utilizing the cross-sectional mean in Eq. (8):

$$\gamma_{it} = Y_{it} / \left(1/N \sum_{k=1}^N Y_{kt}\right) = \delta_{it} / \left(1/N \sum_{k=1}^N \delta_{kt}\right), \quad (8)$$

γ_{it} denotes transition path associated with the cross-section mean. The ratio of cross-sectional variation could be obtained as in Eq. (9):

$$H_t = 1/N \sum_i^N (\gamma_{it} - 1)^2, \quad (9)$$

The log- t approach tests validity of club convergence in the null ($H_0 = \delta_i = \delta$ and $\zeta \geq 0$) and invalidity of club convergence in the alternative. These hypotheses could be tested as in Eq. (10):

$$\text{Log}(H_1/H_t) - 2\text{Log}L(t) = a + b \log t + \varepsilon_{2t}, \quad (10)$$

for $t = [\varphi T], [\varphi T] + 1, \dots, T > 0$ where $L(t) = \log(t)$, and Phillips and Sul (2007) suggest that φ is in the range $[0.2, 0.3]$. The log- t method adopts a one-sided t -test. Therefore, the null of club convergence can be rejected when the t statistic is not up to -1.65 at the 5% level. Burnett (2016) emphasized that the log- t method provides robust estimation in the case of stationarity of the variables and the existence of heterogeneity.

4 Empirical Results

We begin reporting the results by evaluating the beta convergence analysis and the results reported in Table 3. There is empirical support for absolute convergence, as the coefficient of the lag of income inequality is negative and significant for the Full sample from 1870 to 2018. There is also evidence for conditional convergence for the same period, as the coefficient of the lag of income inequality is negative and significant when economic growth

Table 3 Beta convergence

Coverage	Constant	GIN_t / μ_{t-1}	Economic growth	Population growth
Full sample (1870–2018)	0.062*** (5.973)	-0.018*** (-6.207)		
Full sample (1870–2018)	0.060*** (5.758)	-0.018*** (-6.146)	0.041*** (3.804)	0.123* (1.938)
The first globalization boom (1870–1918)	0.050*** (2.338)	-0.015*** (-2.434)		
The first globalization boom (1870–1918)	0.051** (2.349)	-0.015*** (-2.431)	0.016 (0.918)	-0.075 (-0.914)
The Great Depression (1919–1945)	0.062* (1.701)	-0.020* (-1.921)		
The Great Depression (1919–1945)	0.062* (1.744)	-0.020** (-2.021)	0.064*** (3.055)	0.212** (2.192)
Post-World War II-period (1946–2018)	0.108*** (5.964)	-0.032*** (-5.973)		
Post-World War II-period (1946–2018)	0.113*** (6.092)	-0.034*** (-6.117)	0.035* (1.932)	0.105 (0.779)
Post-Oil Crisis period (1974–2018)	0.051*** (2.701)	-0.015*** (-2.642)		
Post-Oil Crisis period (1974–2018)	0.050*** (2.548)	-0.014*** (-2.437)	-0.001 (-0.038)	-0.091 (-0.487)

The estimates are free serial correlation and heteroskedasticity. T-statistics are in the parentheses

*, ** and *** are 10, 5 and 1% significance level

and population growth are added to the regression. Moreover, these two additional series have a positive and significant impact on the growth paths of income inequality. The conditional convergence test results suggest that the countries are converging, but conditional on the two structural factors-economic growth and population growth. The same scenario also emerges when the convergence tests are conducted for different sample periods, which provide for the breaks associated with the Second World War II and the 1973 oil crisis.

The sigma convergence outcomes are shown in Table 4. The empirical findings demonstrate that the time trend parameter is negative and significant, signifying a reduction in the dispersion of income inequality across countries over time. One can infer that there is also empirical support for sigma convergence by using the coefficient of variation as a proxy of dispersion. The data were divided into various time periods and re-examined, but the outputs are not materially different.

The standard deviations and coefficient of variation are further plotted in Fig. 2 and 3, and it can be seen that both the standard deviation and coefficient of variation have decreased in most cases.

One of the major disadvantages of both beta and sigma convergence is that they do not provide insights into the number of countries that may have been responsible for the observed convergence. Hence, we proceed with the analysis with a stochastic convergence analysis. We implement a bias-adjusted CSD test to examine whether CSD exist. The empirical results in Table 5 reveal that the null hypothesis of no CSD is rejected, implying that CSD exists among panel members.

Consequently, we implement second-generation panel data methods. To investigate whether the income inequality data for the included countries have a convergent pattern, we conduct a traditional panel stationarity test as recommended by Bai and Ng (2005) under the assumption of nonexistence of structural changes. The panel results (P_{PC} and $P_{M,PC}$) of the Bai and Ng (2005) test revealed that the null hypothesis of stationarity is rejected. On the one hand, the panel result of (W_{λ}) stationarity test assuming the occurrence of sharp structural breaks proposed by Carrion-i-Silvestre et al. (2005) shows that the null of stationarity of income inequality cannot be rejected. On the other hand, panel results of the stationarity test with smoot shift (W_k) proposed by Nazlioglu and Karul (2017) and the recently proposed stationarity test with smooth shift based on the combination of p -values ($P(k)$, $P_m(k)$, $Z(k)$) developed by Nazlioglu et al. (2021) show that the null hypothesis of stationarity of income inequality can be rejected. Thus, a significant proportion of the panel statistics show that income inequality does not exhibit a mean-reverting process in these 21 countries. Hence, the stochastic convergence of income inequality hypothesis does not hold in these countries.

It is well known that panel stationarity tests have a strict assumption that the stationarity of all individual members is accepted in case of acceptance of the null hypothesis. Therefore, examining the properties of relative data of specific members could provide profound insights into the stochastic convergence tendency of each country (Erdogan & Acaravci, 2019). The individual test statistics are reported in Table 6. The individual PANIC test results show that the null hypothesis of stationarity is rejected in Spain, Denmark, the Netherlands, France, Norway, the United Kingdom, and the United States at a maximum statistical significance level of 10%, whereas it cannot be rejected for the remaining countries.

Moreover, using the individual panel Kwiatkowski-Phillips-Schmidt-Shin (PANKPSS) test of Carrion-i-Silvestre et al. (2005), the results demonstrate that the null hypothesis of stationarity cannot be rejected for all these 21 countries. The break dates show that the first breaks generally occurred either before the postwar period or during major events

Table 4 Sigma convergence test

Coverage	Standard deviation		Coefficient of variation	
	Constant	Trendstion (-1)	Constant	Trendstion (-1)
Full sample (1870–2018)	0.254*** (62.635)	-0.001*** (-14.177)	6.908*** (50.751)	-0.023*** (-12.138)
The first globalization boom (1870–1918)	0.244*** (101.201)	-0.001*** (-5.000)	6.588*** (72.949)	-0.010*** (-2.691)
The Great Depression (1919–1945)	0.375*** (15.214)	-0.003*** (-6.943)	10.359*** (15.628)	-0.069*** (-6.812)
Post-Oil Crisis period (1974–2018)	0.207*** (4.564)	-0.001 (-1.486)	6.695*** (4.898)	-0.020* (-1.854)

The estimates are free serial correlation and heteroskedasticity. T-statistics are in the parentheses

*, **, and *** are 10%, 5% and 1% significance level

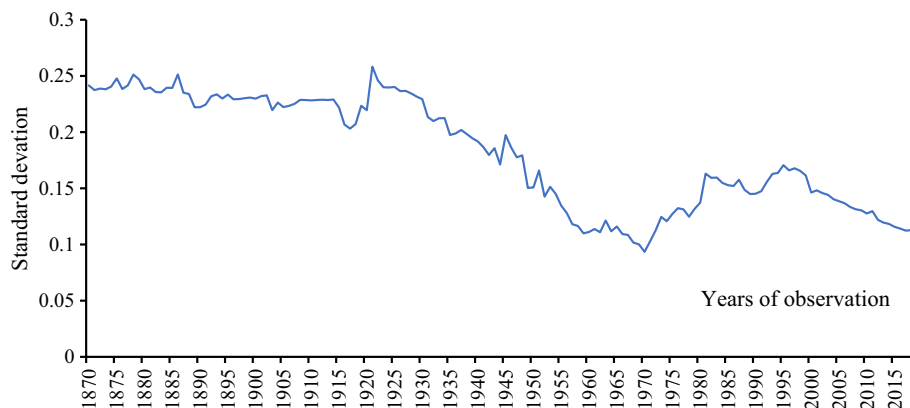


Fig. 2 Standard deviation of income inequality in 21 OECD countries, 1870–2018

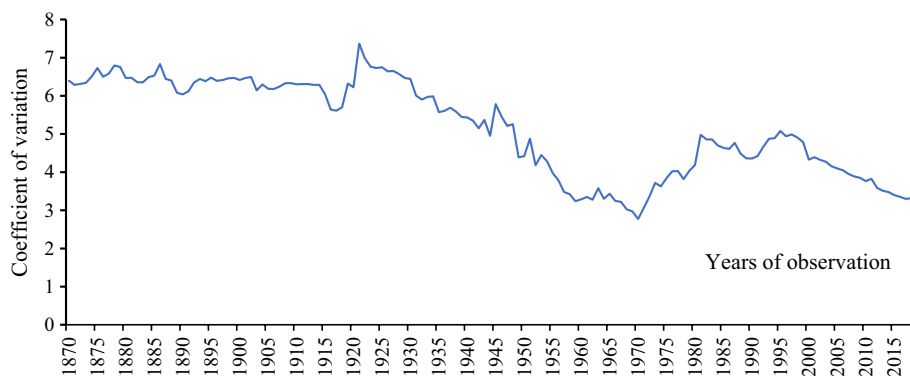


Fig. 3 Coefficient of variation of income inequality in 21 OECD countries, 1870–2018

Table 5 Panel stationarity tests results

Test	Statistics	Probability
P_{PC}	94.699	0.000
$P_{M,PC}$	5.750	0.000
W_{λ}	-1.776	0.985
W_k	3.018	0.001
$P(k)$	68.003	0.007
$P_m(k)$	2.837	0.002
$Z(k)$	-1.873	0.031
LM_{adj}	511.825	0.000

such as World War II, the Great Depression, and the Oil Crisis. It can be said that second breaks show similar characteristics with first break dates. In addition, third break dates generally occurred after the post-period of the Washington Consensus. Therefore, it can be concluded that political, economic and social events affected the dynamic movement of

Table 6 Individual test results

Countries	PANIC	Prob	FKPSS	Prob	PANKPSS	T1	T2	T3	N	10%	5%	1%
Australia	0.029	0.903	0.012	0.998	0.009	1936	1958	1980	3	0.040	0.048	0.064
Austria	0.088	0.225	0.039	0.545	0.038	1973	–	–	1	0.071	0.084	0.121
Belgium	0.042	0.708	0.021	0.906	0.014	1951	1994	–	2	0.052	0.061	0.086
Canada	0.086	0.238	0.089	0.137	0.031	1939	1969	1996	3	0.043	0.050	0.069
Denmark	0.122	0.094	0.064	0.261	0.013	1913	1968	1993	3	0.035	0.040	0.051
Finland	0.044	0.669	0.091	0.128	0.017	1891	1920	1980	3	0.035	0.040	0.054
France	0.138	0.065	0.075	0.198	0.014	1948	1988	–	2	0.049	0.058	0.078
Germany	0.033	0.839	0.021	0.902	0.018	1948	–	–	1	0.057	0.066	0.083
Greece	0.066	0.390	0.058	0.315	0.014	1948	1972	–	2	0.050	0.058	0.081
Ireland	0.029	0.903	0.039	0.545	0.019	1927	1949	1979	3	0.036	0.042	0.056
Italy	0.083	0.257	0.123	0.059	0.025	1905	1973	–	2	0.041	0.048	0.063
Japan	0.049	0.605	0.029	0.736	0.010	1933	1960	1982	3	0.038	0.044	0.060
Netherlands	0.311	0.001	0.256	0.003	0.025	1891	1939	1970	3	0.033	0.036	0.047
New Zealand	0.041	0.724	0.057	0.317	0.016	1940	1962	1990	3	0.042	0.049	0.069
Norway	0.120	0.099	0.072	0.215	0.013	1893	1918	1959	3	0.036	0.041	0.052
Portugal	0.049	0.607	0.048	0.419	0.016	1920	1950	1987	3	0.032	0.036	0.046
Spain	0.514	0.000	0.155	0.027	0.021	1944	1979	–	2	0.045	0.054	0.073
Sweden	0.065	0.402	0.036	0.590	0.022	1895	1950	1978	3	0.033	0.037	0.047
Switzerland	0.090	0.213	0.028	0.764	0.020	1934	1958	1992	3	0.039	0.045	0.062
United Kingdom	0.353	0.000	0.130	0.049	0.013	1918	1964	1989	3	0.033	0.037	0.048
United States	0.279	0.002	0.193	0.012	0.031	1967	1989	–	2	0.063	0.075	0.104

N Break number, T Time breaks

Table 7 Individual RALS-LM unit root test results

Countries	Stat	ρ^2	T1	T2	10%	5%	1%
Australia	-1.364	0.535	1938	1961	-2.546	-2.862	-3.478
Austria	-6.055***	0.576	1977	1991	-2.546	-2.862	-3.478
Belgium	-4.584***	0.604	1948	1970	-2.619	-2.932	-3.543
Canada	-4.472***	0.640	1944	1954	-2.619	-2.932	-3.543
Denmark	-4.090 ***	0.806	1889	1902	-2.742	-3.044	-3.605
Finland	-2.462	0.658	1885	1948	-2.619	-2.932	-3.543
France	-3.166**	0.613	1938	1949	-2.619	-2.932	-3.543
Germany	-4.862***	0.629	1943	1951	-2.619	-2.932	-3.543
Greece	-2.762*	0.716	1948	1951	-2.683	-2.990	-3.605
Ireland	-2.796**	0.470	1930	1976	-2.461	-2.784	-3.398
Italy	-0.688	0.684	1886	1988	-2.619	-2.932	-3.543
Japan	-3.751***	0.702	1948	1957	-2.683	-2.990	-3.605
Netherlands	-0.444	0.834	1886	1910	-2.742	-3.044	-3.653
New Zealand	-3.740***	0.674	1949	1958	-2.619	-2.932	-3.543
Norway	-1.003	0.733	1978	2000	-2.683	-2.990	-3.605
Portugal	-4.864***	0.672	1939	1981	-2.619	-2.932	-3.543
Spain	-1.429	0.624	1951	1957	-2.619	-2.932	-3.543
Sweden	-2.117	0.764	1887	1946	-2.683	-2.990	-3.605
Switzerland	-4.176***	0.800	1934	1938	-2.742	-3.044	-3.653
United Kingdom	-0.350	0.750	1932	1941	-2.683	-2.990	-3.605
United States	-1.717	0.804	1913	1973	-2.742	-3.044	-3.653

T: Break Dates, Critical values are obtained from Meng et al., (2014:351)

*, ** and *** are 10%, 5% and 1% significance level

income inequality, and neoliberal economic policies had an impact on the dynamic pattern of income inequality.

The RALS-LM estimates in Table 7 indicate that the null hypothesis of the unit root cannot be rejected at a statistical significance level of at least 10% in Australia, Finland, Italy, the Netherlands, Norway, Spain, Sweden, the United Kingdom, and the United States, while it cannot be rejected for the remaining countries. The obtained break dates show a relatively similar pattern to the results of the PANKPSS test. Moreover, using the individual Fourier panel Kwiatkowski–Phillips–Schmidt–Shin (FKPSS) test of Nazlioglu and Karul (2017), the results show that the null hypothesis of stationarity can be rejected with a statistical significance level of at least 10% in Italy, the Netherlands, Spain, the United Kingdom, and the United States, whereas it cannot be rejected for the remainder. Table 8 summarizes the findings of the unit root and stationarity tests for income inequality convergence. Figure 4 also indicates that the Fourier approximation can successfully capture changes in the nature of the data and give an idea of future movements in the trend of relative income inequality.

Finally, we reported the results of the log-t method in Table 9. The results show that there are two convergent clubs and club one has the most members with 16 countries, while club two has the fewest members with five countries. In order to test whether convergence between club one and club two is possible, we tested merging clubs (Phillips & Sul,

Table 8 Summary of the outcomes

Countries	PANIC	FKPSS	PANKPSS	RALS-LM
Australia	●	●	●	
Austria	●	●	●	●
Belgium	●	●	●	●
Canada	●	●	●	●
Denmark		●	●	●
Finland	●	●	●	
France		●	●	●
Germany	●	●	●	●
Greece	●	●	●	●
Ireland	●	●	●	●
Italy	●		●	
Japan	●	●	●	●
Netherlands			●	
New Zealand	●	●	●	●
Norway		●	●	
Portugal	●	●	●	●
Spain			●	
Sweden	●	●	●	
Switzerland	●	●	●	●
United Kingdom			●	
United States			●	

● illustrates the stationarity of income inequality at least the 10% significance level

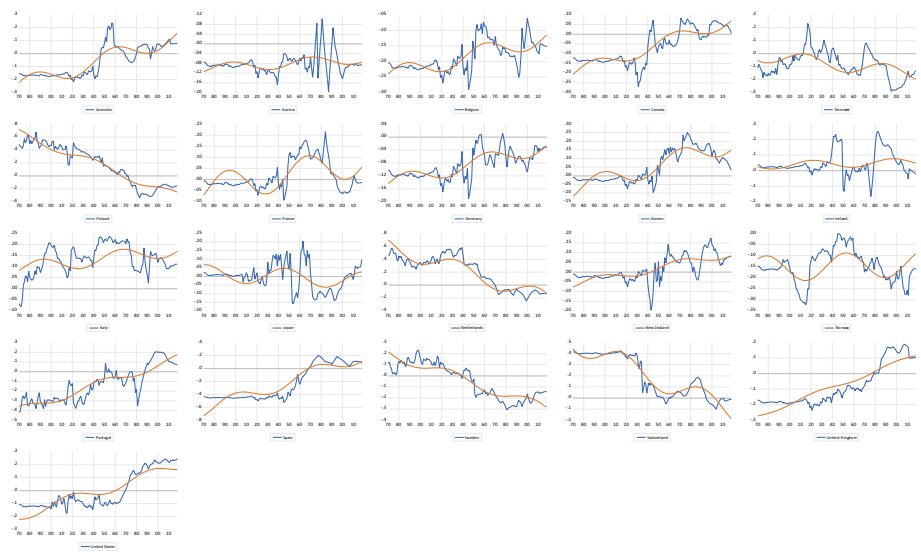


Fig. 4 Fourier approximation

Table 9 Club convergence analysis

High-Income Countries			
	Coefficient	Standard Error	t-stat
Club 1	−0.242	2.053	−0.117
Club 2	6.081	1.154	5.269
Club 1 + 2	−1.683	0.013	−124.202

2009). According to the test results, we did not observe convergence in income inequality between club one and club two.

5 Discussion

The results show a generally convergent pattern of income inequality across OECD countries, which is consistent with the results in the papers of Chambers and Dhongde (2016) on several nations, Mendoza-Velázquez et al. (2019) on Mexican states, and Ivanovski et al. (2020) on Australian territories. Therefore, it is reasonable to assume that unequal income distribution tends to decrease in countries with initially high-income inequality and that those with initially low-income inequality catch up when appropriate policies are implemented. These facts provide us an insightful understanding of the nature of income inequality in OECD countries. Arcabic et al. (2021) emphasized that the converging trend in income inequality could be associated with a converging income pattern. De la Fuente (2003) showed that OECD countries have a convergent income pattern. Therefore, having similar income dynamics may lead to similar wealth inequality in OECD countries. Most of the individual members included in the empirical analysis are members of the European Union (EU). The EU can boost economic growth and allow new members to catch up with the initially wealthy ones. This may result in income convergence, which in turn supports the convergence of inequalities. Moreover, the EU provides an opportunity to increase economic performance and improve institutional quality by preventing corruptive practices, implementing institutional reforms, ensuring the rule of law, and encouraging social policies for disadvantaged groups. Hence, EU membership can lead to having similar living standards to included EU countries (Czasonis & Quinn, 2012).

In addition, most of the OECD countries have experienced a stable economic, political, and social environment in recent history (Akalin & Erdogan, 2021). Having a steady developing path can prevent fluctuations in population, such as stabilizing mortality preventing intra- and inter-regional migration, which in turn controls fluctuations in income inequality (Ivanovski et al., 2020). In OECD countries, the average enrollment rate in higher education is similar to the world, while some of the OECD countries have significantly higher enrollment rates than the world average (OECD, 2022; World Bank, 2022). High levels of education could contribute to forming a skilled individual class; thus, increasing the number of educated people can increase the numbers of individuals belonging to the middle class (Acemoglu & Robinson, 2002). This may contribute to an increase in income levels, which in turn triggers a mechanism of income convergence, which in turn promotes convergence in income inequality.

Another probable reason for the income inequality convergence is the prevailing convergence of economic policies in industrialized countries. Because of rapid globalization, several industrialized countries over the years have liberalized capital movements, encouraged

labor migration, reduced trade barriers, and supported rapid technology transfer (Ravallion, 2003). There are now numerous economic unions and trade blocs that require participating members to adopt similar economic policies. It is likely that these developments have similarly affected income inequality within these countries. Indeed, World Bank (2022) has shown that differences in income inequality across the 21 OECD countries in our sample have narrowed significantly in recent decades. Therefore, income distributions in developed countries are gradually becoming more skewed, but at the same time more similar to each other (Chambers & Dhongde, 2016).

The club convergence results suggest multiple equilibria may be due to geographic proximity. As shown in Table 10, Club 2 consists of Belgium, Denmark, Finland, the Netherlands, and Sweden. Thus, Denmark, Sweden, and Finland, located in the Scandinavian region, share common frontiers, while Belgium and the Netherlands are two of the three Benelux countries and share common borders. It could be said that geographical proximity can lead to similar informal institutions such as cultural heritage, traditions, common practices, and customs that determine formal institutions such as the legal system, property rights, and contracts (North, 2012). Therefore, a similar institutional structure can lead to similar welfare conditions in these countries; thus, multiple equilibria occur.

The conditional convergence test results show that the convergence of income inequality is conditional on economic and population growth, even when the entire time period and different sample periods are considered. Economic growth fueled by service sector expansion is likely to favor urban populations and the better educated, as they are likely to experience larger income gains. Therefore, such an expansion could lead to more inequality, as it is unlikely to significantly affect the income growth of the rural population and the less educated. Population growth generates greater competition for jobs, which limits employment opportunities and exacerbates income inequality across countries. In addition, higher rates of immigration (which frequently swell the population size of OECD countries) can also intensify inequality (especially inequality of opportunity) by triggering greater wealth concentration among native-born citizens.

6 Conclusion

Income inequality in many countries, inclusive of OECD members, has been at its peak for the last few decades. Various initiatives have been introduced in many economies aimed at improving income distribution. Reducing inequality among and within countries is one of the 17 goals in the 2030 Agenda for Sustainable Development. To properly address income inequality, there is a need to understand different dimensions of the income distribution, especially the aspects that have not been sufficiently explored in the literature. The main purpose of this paper is to examine the dynamic behavior of the income inequality in OECD countries by implementing traditional and newly developed panel data methods, including panel stationarity tests introduced by Nazlioglu et al. (2021), which allows for structural shifts and cross-sectional dependence, to examine the stochastic convergence of income inequality. The empirical findings can be summed up as follows. (i) Beta convergence test results reveal that there is strong evidence of absolute and conditional convergence in the OECD countries. The conditional convergence test results suggest that the convergence of income inequality is conditional on economic growth and population growth. (ii) Sigma convergence results validate that dispersion of series decreases in the used period, which illustrates the existence of

Table 10 Club memberships for income inequality

	Club 1	Club 2
Countries	Austria, Australia, Canada, France, Greece, Germany, Italy, Ireland, Japan, Norway, New Zealand, Portugal, Switzerland, Spain, United Kingdom, United States	Belgium, Denmark, Finland, Netherlands, Sweden

sigma convergence. (iii) Traditional and newly developed Fourier PANIC panel stationarity test results indicate that stochastic divergence exists at the panel level. In contrast, evidence of stochastic convergence is examined in some individuals in the panel. (iv) Club convergence test results show two convergent clubs in the OECD countries, confirming the existence of multiple equilibria.

An implication of the convergence results is that one may expect that unequal income distribution in the countries with initially high-income inequality tends to decrease and catch the countries up with initially low-income inequality if adequate policies are put in place (especially in high-income inequality countries). The likely policies that tend to reduce income inequality include continuous investments in education and skills because they promote equal opportunities. Up-skilling of low-skilled employees is one of the effective mechanisms to counter dispersions in wages while also generating more employment opportunities (European Commission, 2017). For young people and children, education is potent at inducing more equal opportunities provided all young people have similar access to good education, irrespective of their background.

The tax and benefit system is another vital policy option that may improve income distribution. While blueprints to deal with skills deficits are valuable in the medium to long term, changes to the tax and benefit system may have an immediate impact. For instance, improving the inheritance and property taxation system could also provide a viable channel to ensure equal wealth distribution and fairness in opportunities. Some countries, including Denmark, Hungary, and Ireland, use the tax and benefit system to decrease steep market income inequalities (European Commission, 2017).

The convergence of income inequality also implies that there is a need for mutual policies among the OECD nations to address income inequality in addition to country-specific policies. Moreover, there is a need for coordination of income inequality programs among the OECD countries since they are moving towards a similar steady-state. It is not startling to see countries coming together and synchronizing their efforts to mutually lessen inequality. Many countries, including the OECD countries, have ratified the United Nations adoption of the Sustainable Development Goals of 2015. Among the 17 goals is to lessen inequality within countries. Moreover, one of the 20 principles of The European Pillar of Social Rights Action Plan is the provision of equal opportunities irrespective of racial or ethnic origin, gender, religion or belief, age, or disability by 2030.

The results, which show that the convergence of income inequality is conditional on economic growth, imply that faster and balanced growth patterns are required to attain real convergence and a desirable level of income inequality. Hence economic growth rate should be categorized such that growth by racial or ethnic origin, gender, religion or belief, age or disability should be analyzed, and efforts to increase the economic development of these subsamples should be intensified. The results show that the convergence of income inequality is conditional on population growth, implying that addressing demographic issues such as population density can help reduce income inequality in most countries.

Evidence shows that population density has increased steadily in OECD countries over the years (World Bank, 2022).

Analyzing data from 2020 onwards, which are not currently available for these nations, will provide fresh insights into the evolution of income inequality and the impacts of the blueprint introduced by the OECD nations, including the €750 billion EU stimulus (involving several OECD countries) and the \$1 trillion U.S. stimulus (Bloomfield & Steward, 2020). In future research, it would also be ideal to examine the effect of the recession triggered by the COVID-19 pandemic on inequality and convergence patterns. As more datasets become available in the future, subsequent papers can investigate additional determinants of the convergence of income inequality series as such an endeavor would allow inferences to be made about the economic and non-economic variables driving the series.

Finally, the results of the individual stationarity and unit root tests show that one cannot draw firm conclusions about the presence of stochastic convergence in Italy, as two of the methods are in favor of divergence, while the rest are in favor of convergence. Future work might therefore consider investigating the Italian case in depth. In addition, future studies can apply probit/logit models to determine the driving factors for club convergence. Besides, researchers can specify club transition paths. In this way, policy makers and scientists can access further information about the club convergence of income inequality.

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