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IMPACT OF CLIMATE CHANGE ON INCOME INEQUALITY. IMPLICATIONS FOR RICH AND POOR COUNTRIES

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ABSTRACT: The article aims to provide evidence of the link between income inequality and climate change in both developed and low-income economies. This study uses a descriptive analysis method along with panel data analysis to assess the impact of climate changes on income inequality in 42 advanced economies and 68 developing countries between 1995 and 2020. The results of empirical research confirm that climate change is an important factor responsible for growing income inequality. The impact of a country's vulnerability is positively associated with increasing income inequality in low-income economies. In turn, climate resilience has a statistically significant effect on income distribution in both groups, although the ability to mitigate climate change and adapt is considerably weaker in developing countries. This research raises our awareness of the links between the economy and climate change, including their implications for income inequality, and signals possible changes in the redistributive system to mitigate climate change and combat income inequality. The added value of this article is the results of research on the negative consequences of climate change on income inequality in over 100 countries. Particular attention was paid to the ethical issue of unequal responsibility for causing climate change between rich and poor countries.

KEYWORDS: climate change, income inequality, economic growth

Introduction

Climate change is a serious challenge of the 21st century, given its worst economic and environmental consequences, which may not only hinder the achievement of sustainable and inclusive economic growth in the future but also cause a real threat to the security of humanity and the ecosystems (Stern, 2015). Climate change can affect economic activity through a variety of channels, leading to increased income inequality. The existing relationship between climate change and income inequality is the subject of research interest for many economists, taking into account the importance of this relationship for ensuring sustainable economic growth. Well-substantiated scientific projections have shown not only the devastating consequences of climate change but also the asymmetric responsibility between climate change on the one hand and vulnerability on the other (Cevik & Jalles, 2020).

Climate change is undoubtedly one of the main obstacles to sustainable growth and contributes to significant socio-economic damage. Bearing in mind that climate change disproportionately affects the poorest, we formulate the research hypothesis that climate change has a negative impact on income distribution and may deepen income inequality between countries.

The purpose of this article is to shed light on how climate change affects income inequality. To fill the research gap and better understand the relationship between income distribution and climate change, we outline the macroeconomic impacts of climate change. The study also explores the interrelationships between income inequality and climate change, elucidating the possible implications of environmental degradation for future trends in global income inequality. Extensive panel data covering the period 1995-2020 was used for the empirical study. The countries were divided into two groups. The first group consists of 42 developed economies, and the second group consists of 68 developing countries.

The main finding of this article is that climate change negatively affects the global economy, leading to growing income inequality. Low-income economies are particularly vulnerable to climate change, although their historical responsibility for this is low. Similarly, the share of the poorest income groups in global carbon emission is relatively low. We found that climate vulnerability is linked to increasing income inequality in low-income countries. Unfortunately, the ability of poor countries to mitigate climate change and adapt is considerably weaker than that of rich countries.

An overview of the literature on the macroeconomic effects of climate change

Our article can be linked to two main strands of recent research. Firstly, this article adds to the literature on the macroeconomic impacts of climate change. The literature explains that the probability of dangerous weather events can be equated with climate risk, which is divided into two categories (IPCC, 2022). On the one hand, there is the physical risk of climate change related to damage caused by weather anomalies such as hurricanes, heat waves, droughts and floods. This type of risk can lead to large economic and financial losses due to potentially serious damage to the flow of income and assets of households, companies, banks and insurers (Cevik, 2022). In addition, the physical risk of climate change can negatively impact fiscal performance and debt sustainability, with negative repercussions across the economy (Batten, 2018; Campiglio, 2018).

On the other hand, transition risks of climate change appear as a result of efforts made to build a green economy. It can be said that transition risks materialise mainly when changes in technology, standards, taxation, and other policies turn carbon-intensive assets into stranded assets and boost losses through financial interconnectedness (Agarwala et al., 2021; Cevik & Jalles, 2020, 2022a, 2022c).

The impact of climate change on the global economy is felt almost worldwide due to its financial, economic and political integration. Global warming has the potential to seriously harm economic growth through damage to private property and public infrastructure, resulting in reduced productivity, mass migration and loss of security.

Given that climate change causes a decrease in production, income, productivity and consumption, this will reduce the propensity of enterprises to invest and thus lower the investment rate. There is no doubt that climate change can negatively affect both supply and demand. As a result, along with

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climate change, we should expect a decline in economic growth and higher inflation, and thus an increase in the costs of food, energy and insurance (Mejia et al., 2018).

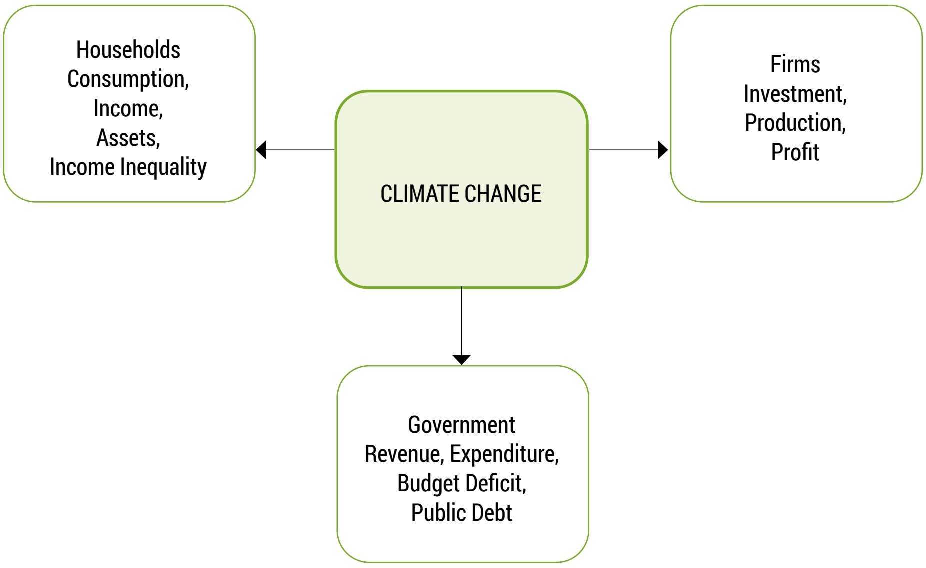

Figure 1. Impact of climate change on the economy

Table 1. Effect of climate changes on GDP

Study	Baseline scenarios	Impact (% of GDP)
Nordhaus (1994)	3°C global warming	The results of experimental model indicates that the effect of 3°C global warming contributes to the loss of 1.3% of GDP.
Fankhauser (1995)	2.5°C global warming	The overall impact of climate change on economic growth is estimated at minus 1.3% of GDP.
Mendelsohn et al. (2000)	2.5°C by 2100	Cumulative market impact costs do not exceed 0.1% of GDP.
Stern (2006)	between 2.4°C and 5.8°C global warming by 2100	An average loss of 5% of global GDP yearly is projected over the next two centuries.
Dell et al. (2012)	2,2°C global warning on average	First, a 1°C increase in temperature slows economic growth by 1.3% per year, but only in poor countries. Second, higher temperatures have a negative impact on both level of production and economic growth. Third, global warming has broad-spectrum effects, negatively affecting agricultural and industrial output and worsening political stability.
IPCC (2014)	approximately 2.0°C global warming by 2030	Under this scenario, annual economic output can fall from the 0.2% to 2.0% of GDP.
Dellink et al. (2014)	from 1.5°C to 4.5°C global warming by 2060	The analysis shows that the impact of climate change on annual global GDP will increase, resulting in a loss of global GDP ranging from 0.7% to 2.5% by 2060.
Mejia et al. (2018)	4°C or more global warming by the end of the century.	Model projections suggest that rising temperatures would contribute to a loss of 9% of GDP for low-income economies by 2100.
Kahn et al. (2019)	an average increase in global temperature by 0.04°C per year	The reduction in world real GDP per capita by more than 7% by 2100.
Maino and Emrullahu (2022)	a 1°C rise in temperature	The results reveal that temperature anomaly negatively affects the growth rate of income per capita on average across all countries. The worst-off regions of Africa may lose by −2.4% of GDP.

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The overview of empirical research on economic losses measured in % of GDP from climate change is presented in Table 1. The main conclusions drawn from these studies seem to suggest that, first, climate change is indeed a determining factor for economic growth. Second, the scale and direction of climate change impacts vary depending on geographic and socio-economic conditions. Regardless of the baseline scenario, the conducted research confirms that global warming will pose a real threat to sustainable economic growth.

Nexus between income inequality and climate change

In recent years, much attention has been paid to the impact of climate change on economic growth. Regardless, empirical evidence on how climate change might affect income distribution is still limited. There are several studies of economic inequality that show that climate change exaggerates inequality between countries (Islam & Winkel, 2017; Diffenbaugh & Burke, 2019; Cevik & Jalles, 2022b). At the same time, it can be clearly emphasised that most of these studies used global aggregated data, while only limited extensive evidence was found on intra-country inequality and its relationship to climate change (Hsiang et al., 2017; De Laubier-Longuet et al., 2019; Sedova et al., 2020).

Climate change has an impact on inequality between countries in two ways. First, rising temperatures cause impacts that fall more heavily on the lowest developing countries and the poorest income groups. Second, the costs of mitigating climate change by reducing greenhouse gas emissions could slow down the economic catch-up of poor countries. The impact of climate change on inequality depends, to a large extent, on the structural conditions of a given economy. Weather anomalies reduce agricultural production, which affects farmers' incomes negatively, especially rural incomes in developing countries (Asfaw et al., 2020). Not only farmers but also consumers may be affected by climate change due to the increase in food prices (Janssens et al., 2020). Moreover, it should be taken into account that the most vulnerable households often live in rural areas with less favoured agricultural land and poor access to the market (Wunder et al., 2018). In addition, they are more vulnerable to climate change risks because their assets and employment are determined by environmental constraints, scarcity or variability (Narloch & Bangalore, 2018).

There is no doubt that a much broader view of the relationship between income inequality and climate change is needed. Understanding the causes of growing income inequality seems crucial to achieving economic development. However, the literature on the determinants of income inequality tends to overlook the role that climate change plays as a driver of inequality. Kuznets (1955) suggested that patterns of income inequality are related to the level of economic development by means of an inverted U-shaped relationship. However, the results of empirical studies on the relationship between economic growth and inequality are mixed (Barro, 2008; Huang et al., 2015; Cerra et al., 2021). It is worth emphasising that Stiglitz (2012) pointed to the devastating impact of monetary and budgetary policy and globalisation on the increase in inequality, while Atkinson et al. (2011) to changes in taxation that reduced progressivity, particularly at the top of the distribution, as the main causes of inequality. The fact that an increase in the top tax rates is associated with a decrease in the net GINI has been confirmed in many empirical studies (Causa et al*.,* 2018; Chen et al., 2018; Doumbia & Kinda, 2019; Clifton et al., 2020; Gunasinghe et al., 2021; Wildowicz-Szumarska, 2022). In addition, the flexibilisation of the labour market, the weakening of trade unions, and the financialisation and reduction of the welfare state are some of the most important factors explaining the explosion of income inequality after transfers and taxes in the last two decades (Causa et al., 2018; Younsi et al*.,* 2020; Furceri et al., 2020; Wildowicz-Szumarska, 2022).

Income inequality has increased in most countries over the past two decades, whereas income inequality between countries based on per capita income has likely decreased. Recent data showed that inequality between countries accounted for 32% of global inequality. This means that the rest is due to inequality within countries (Chancel et al., 2022; Development Initiative, 2022). The gap between the global average incomes of the top 10% and the bottom 50% of individuals within countries has almost doubled (from 8,5x to 15x) in the period of 1910-2020 (Chancel et al*.,* 2022).

Figure 2 shows regional differences in income inequality. The presented data confirm that the lowest income inequality occurs in Europe, while the highest is in the Middle East and North Africa (MENA). The top 10% in Europe captures around 36% of national income and almost 60% in the MENA region, respectively.

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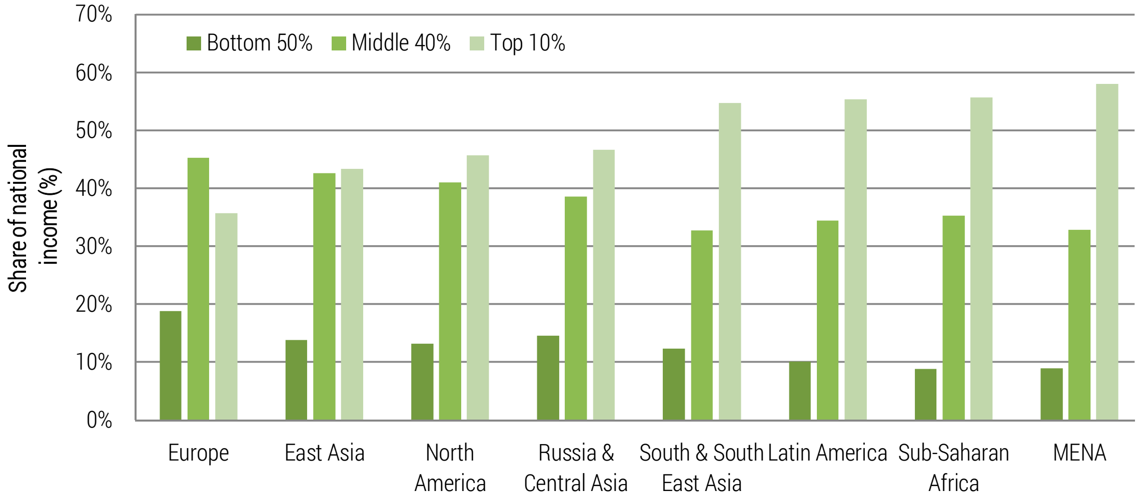

Figure 2. Income inequality across the regions in 2021

Source: authors' work based on Chancel et al. (2022).

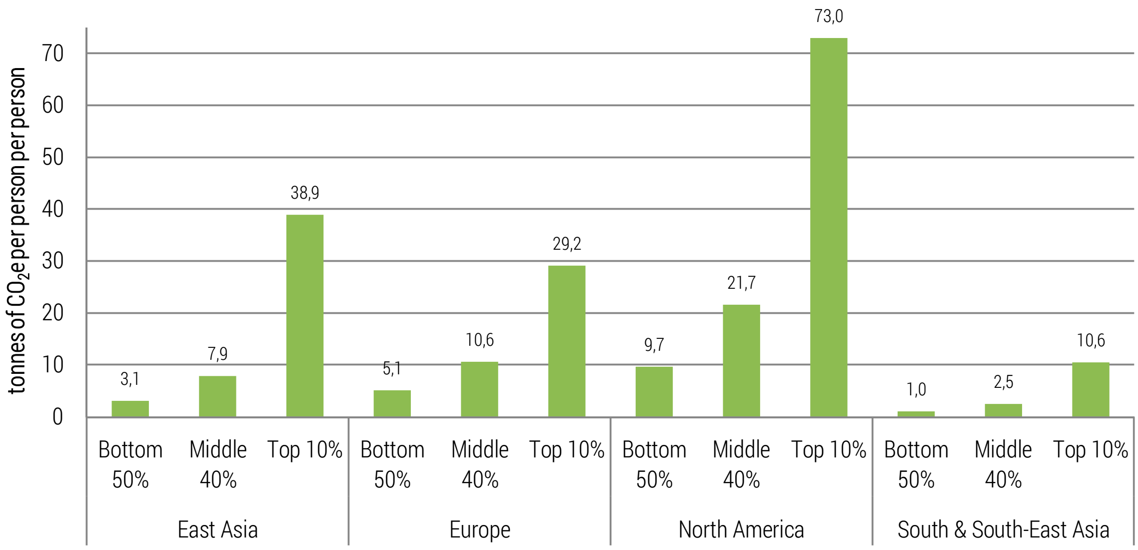

Figure 3. Per capita emissions across the world

Source: authors' work based on Chancel et al. (2022).

When looking at the link between income inequality and climate change, it is important to note that global income inequality is closely related to ecological inequality (Millward-Hopkins & Oswald, 2021; Khan & Yahong, 2021). These inequalities cannot simply be seen as a problem of rich and poor countries because, first and foremost, income should be seen as a key determinant of environmental impact. It is clear that the higher people's incomes, the more they consume and the more greenhouse gases (GHGs) they produce as a result of their consumption.

Data on carbon emissions inequality shows that the top 10% of emitters are responsible for close to 50% of all emissions, while the bottom 50% of individuals produce only 12% of the total. Significant inequalities in carbon footprints are globally observed. Figure 3 presents the carbon emission by income groups. In the US, the richest 10% of the population emits seven times more per capita yearly (73 tonnes) compared to the poorest 50% (9,7 tonnes). Generally speaking, similar trends are observed in all regions, but it has to be underlined that US average emissions are 3.2 times the world average. In Europe, the top 10% contributes to the emission of 29,2 tonnes per capita (almost six times more than the bottom 50%), whereas in South & Southeast Asia, the emission of the top 10% is estimated at 10,6 tonnes annually (10 times more than the carbon footprints of the poorest 50%).

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Research methods

Our empirical method is based on a panel data approach to assess the impact of climate change on income inequality while also taking into account other important determinants of income inequality identified in the literature. The empirical analysis covers a large collection of 42 developed economies and 68 developing countries from 1995 to 2020. We use the World Bank classification of countries by income group. The first group includes only high-income countries, and the second group consists of low-income countries along with lower-middle-income countries. Table 2 presents the countries included in the sample.

Table 2. Sample selected for empirical analysis was divided into income groups

high-income countries
Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherland, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom, United States, Australia, Brazil, Canada, China, Iceland, Israel, Japan, New Zealand, Norway, Panama, Singapore, Switzerland, Turkey
low-income countries
Afghanistan, Burundi, Burkina Faso, Central African Republic, Guinea, Gambia, Guinea-Bissau, Liberia, Madagascar, Mali, Mozambique, Malawi, Niger, Rwanda, Sudan, Sierra Leone, Somalia, South Sudan, Chad, Togo, Uganda, Yemen, Zambia
lower-medium income countries
Angola, Benin, Bangladesh, Bolivia, Cameroon, Côte d'Ivoire, Djibouti, Algeria, Egypt, Micronesia, Ghana, Honduras, Haiti, Indonesia, India, Iran, Kenya, Cambodia, Kiribati, Lebanon, Sri Lanka, Lesotho, Morocco, Myanmar, Mongolia, Mauritania, Nigeria, Nicaragua, Nepal, Pakistan, Philippines, Papua New Guinea, Senegal, Solomon Islands, El Salvador, Tajikistan, Timor-Leste, Tunisia, Tanzania, Ukraine, Uzbekistan, Vietnam, Vanuatu, Samoa, Zimbabwe

Our panel data is unbalanced. For the dependent variable, the S80/S20 index from the World Income Inequality Database (WIID) was used instead of the GINI index from the Standard World Income Inequality Database (Solt, 2020). S80/S20 is the ratio of the average income of the richest 20% to the poorest 20%. According to the WIID methodology, pre-tax national income is the sum of all income flows before taxes and transfers, but after taking into account the functioning of the pension system.

Both the climate vulnerability index and climate resilience index are taken from the Notre Dame Global Adaptation Initiative (ND-GAIN) database. Composite indices include 45 indicators. Respectively, 36 variables refer to climate vulnerability, and 9 variables refer to climate resilience. Vulnerability is interpreted as "a country's exposure, sensitivity, and capacity to climate change". Climate vulnerability is measured in sectors such as food, water, health, ecosystem services, human habitat and infrastructure. The climate resilience index, in turn, measures a country's ability to undertake and complete investments. It covers three key areas – economic, governance and social readiness. For the purpose of our analysis, only indexes that are adjusted for the level of real GDP per capita are taken into account. This assumption avoids the problem of their correlation with the other macroeconomic variables.

We assume that the relationship between climate change and income distribution is mainly derived from economic development, globalisation, the quality of institutions and demographic trends. Based on the literature review, we consider determinants of income inequality as control variables, such as real GDP per capita, real GDP growth, consumer price index (CPI) as a measure of inflation, terms-of-trade index (the percentage ratio of the export price index to the corresponding import price index), population (total), age dependency (% of working-age population), population density (people per sq. km of land area), corruption index as a proxy for the quality of institutions and KOF index as a measure of globalisation (Cevik & Jalles, 2022b). The control variables such as: real GDP per capita, real GDP growth, consumer price index, terms-of-trade index, population, age dependency, population density and corruption index come from the World Bank database. In turn, the Financial Globalization Index is provided by the KOF Swiss Economic Institute database of ETH Zurich. Detailed information on the variables is provided in Appendix 1. Formally, we estimate the following regression equation:

$$INEQUALITY_{it} = \alpha + \sum_{j=1}^{k} \beta_j \, Climate\ Change_{jit} + \sum_{j=1}^{n} \gamma_j X_{jit} + u_i + \mu_t + e_{it}, \quad (1)$$

where:
climate $Change_{jit}$ – k-element vector of two variables (climate vulnerability and climate readiness),
X_{jit} – n-element vector of control variables,
u_i and μ_t the time-invariant country-specific effects and the time effects controlling for common shocks that may affect inequality across all countries in a given country,
e_{it} – random error,
α, β_j, γ_j – parameter and vector of parameters, respectively.

To test the hypothesis and obtain the objective of this study, we use panel data estimation techniques and the Generalized Least Squared (GLS) method (Hsiao, 2006). Considering numerous estimation techniques for the panel model, several statistical analyses were conducted in this study, such as: the Welch F-test, Breusch- Pagan test (LM test) and Hausman test to get a more suitable model as a probe. To account for possible heteroskedasticity, robust standard errors are clustered at the country level. In addition, the regression specification RESET test was conducted to check if the models were correctly specified.

Results and Discussion

The authors present the results of country-level panel data regressions covering 42 advanced economies and 68 developing countries from 1995 to 2020. At the first stage of the analysis, the specification formulated in the equation explained in the methodological section was used to assess the impact of climate change on income inequality in advanced economies. The result of diagnostic test F with value p= 0.732 confirms that the pooled OLS model is more appropriate than the fixed-effects model. Similarly, the Breusch-Pagan test statistic with a value p = 0.257 proves that OLS model is more adequate than the random-effects model. The result of the RESET test on specification with a value of p = 0.507 means that we have no grounds to reject the null hypothesis of correct specification. Our estimation results are presented in Table 3.

Table 3. Impact of climate change on income inequality in advanced economies

variables	Model OLS(1)		Model OLS (2)	
	coefficient	p-value	coefficient	p-value
const	0.418	0.763	4.329	0.0182**
GDPpc_1	0.007	0.943	0.024	0.908
POP_1	−0.004	0.776	−0.085	<0.0001***
Density_1	0.1734	<0.0001***	0.118	<0.0001***
Vulnerability_1	0.0179	0.5413	0.0118	0.7366
TOT_1	0.1981	0.0316**	−0.115	0.4661
CPI_1	−0.0187	0.1563	0.0069	0.6899
GDP_1	0.0297	<0.0001***	0.0197	0.0606*
KOF_1	−0.018	0.0108**	−0.033	<0.0001***
AGEDependency_1	1.349	<0.0001***	1.279	<0.0001***
Readiness_1			−0.117	<0.0001***
R-square	0.72		0.84	
No. of observation	87		61	

Dependent variable (Y): Income Inequality – as measured by logarithm of S80/S20; variables: GDPpc, POP, Density, Vulnerability, TOT, Readiness are logarithmised; all independent variables are lagged; Corruption is excluded due to the problem of collinearity; there is no country and year fixed-effect; ***, **, * – statistical significance at the level of 1%, 5% and 10% threshold, respectively; standard errors (robust HAC).

The estimated models show that there are factors that have a positive and significant impact on income distribution in advanced economies. It has to be stressed that climate resilience is one of them. A one percentage increase in the country's climate resilience is associated with a 0.11 decrease in income inequality measured by the S80/S20 ratio. This is in line with the previous empirical research conducted by Cevik and Jalles (2022b). A positive relationship is also found between globalisation measured by the KOF index and income inequality, although existing empirical research on this topic varies. It is worth underlining that the results of previous empirical research suggest that globalisation led to an increase in income inequality in less developed nations (Atif et al., 2012; Bukhari & Munir, 2016; Sengupta, 2021). In addition, the estimations of model OLS (2) prove that the number of population is also linked to the lower income inequality (-0.085 percentage points). However, the effects of population ageing on income distribution contribute to the growth in income inequality (Hwang et al., 2021; Özaytürk et al., 2021). Strong and positive coefficients are found in both estimated models. It turns out that population density has a positive and significant regression coefficient in models OLS (1) and OLS (2). Similar results were achieved by Cevik and Jalles (2022b) on a sample of advanced economies. Taking into account that urban areas are characterised by higher population density compared to rural, we should rather expect that greater urbanisation along with increasing population density should contribute to reducing income inequality, but the empirical findings in this scope are mixed (Wang et al., 2017; Ha et al., 2019).

As the next step of our research, we focus on developing countries. Table 4 reports the estimation results based on country-level panel data. The choice of the pooled ordinary least squares (OLS) model was made on the basis of the results of diagnostic tests. Test F with value p= 0.103 confirms that the pooled OLS model is more appropriate than the fixed-effects model. Similarly, the Breusch--Pagan test statistic with a value p = 0.369 proves that OLS model is more adequate than the random-effects model. The achieved result of the RESET test on specification with value p = 0.183 means that we have no grounds to reject the null hypothesis of correct specification.

Table 4. Impact of climate change on income inequality in developing countries

variables	Model OLS (3)		Model OLS(4)	
	coefficient	p-value	coefficient	p-value
const	1.103	0.229	3.641	0.3115
GDPpc_1	0.344	0.0001***	0.106	0.0004***
POP_1	−0.021	0.328	-0.041	0.677
Valnurebility_1	0.155	0.0004***	0.154	0.107
ToT_1	−0.112	0.29	-0.606	0.0012***
CPI_1	0.0008	0.754	-0.004	0.494
GDP_1	0.013	0.226	0.009	0.62
KOF_1	−0.010	0.09*	-0.01	0.423
AGEDependency_1	0.006	0.032**	0.005	0.232
Density_1	0.0002	0.2721	0.261	0.0018***
Readiness_1			-0.115	0.0004***
R-square	0.21		0.56	

Dependent variable (Y): Income Inequality – as measured by logarithm of S80/S20; variables: GDPpc, POP, Density, Vulnerability, TOT, Readiness are logarithmised; all independent variables are lagged; Corruption is excluded due to the problem of collinearity; there is no country and year fixed-effect; ***, **, * – statistical significance at the level of 1%, 5% and 10% threshold, respectively; standard errors (robust HAC).

In line with other empirical studies (Paglialunga et al., 2020; Cevik & Jalles, 2022b), the estimated coefficient of climate vulnerability has a statistically significant impact on income inequality in model OLS(3). A one percentage point increase in climate vulnerability is associated with a 0.15 percent worsening of income inequality. Moreover, the included index of climate resilience – as an explanatory variable in model OLS(4) – is also statistically significant. The estimation shows that, as in advanced economies, the higher level of overall climate resilience contributes to the decrease in income inequality (0.11 percentage points). A positive and statistically significant relationship is found between income per capita and income inequality in both models, indicating its negative impact on income inequality. This may be due to the fact that a large segment of the population cannot benefit from economic growth in developing countries (Grigoli & Robles, 2017). The impact of population density on income distribution is negative and statistically significant, but only in model OLS(4). In turn, the estimated model OLS(4) shows that the growth in terms of trade ratio (TOT) is linked to lower income inequality. However, as noted above, the empirical findings on the distributional impact of trade expansion and globalisation are mixed.

At the end of the section, it is worth mentioning that an alternative indicator of income inequality in the robustness test is also used. In this case, income equality is measured by the net Gini index from the SWIID (Solt, 2020). The regression results are reported in the appendix. Overall, it can be claimed that the conclusions of this paper are rather robust.

Conclusions

In this study, we synthesised the theory and evidence linking climate change to income inequality. As part of our theoretical deliberations, special attention was paid to the ethical issue of unequal responsibility for causing climate change. It is commonly known that the poorest economies and lowest-income households are most exposed to climate hazards. Our empirical analysis also proved that vulnerability to climate change has a negative impact on income inequality in developing countries. However, looking at the historical distribution of emissions, it is worth noting that rich economies (North America and Europe) are among the largest polluters. In general, the responsibility of the poorest for cumulative global carbon emissions is low compared to the top 10%, which account for close to 50% of cumulative emissions.

The conducted analysis made us realise that the introduction of a new redistributive system to combat climate change, based on progressive taxation – mainly those at the top of the income distribution – and the fight against inequality are only, at first glance, mutually exclusive goals. In the long term, climate change mitigation and the fight against rising income inequality can be reconciled, but it must be stressed that the increase in the tax burden necessary to finance the transition to a green economy should not fall disproportionately on the poorest.

Our article contributes to the ongoing discussions in economics devoted to the main challenges of the global economy in the 21st century in two ways. Firstly, the article provides empirical evidence of the negative impact of climate change on income inequality, indicating future possible research avenues. The relationship between income inequality and climate change should also be analysed through the prism of the structural conditions of a given economy, its institutional capacity or in the context of fiscal policy instruments. Secondly, the article extends the existing knowledge about the mutual links between climate change, income inequality, and ecological inequality. We are entirely convinced of the need to include ethical considerations in further research.

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The contribution of the authors

Conceptualization, A.W.-Sz. and K.O.; literature review, A.W.-Sz. and K.O.; methodology, A.W.-Sz. and K.O.; formal analysis, A.W.-Sz. and K.O.; writing, A.W.-Sz. and K.O.; conclusions and discussion, A.W.-Sz. and K.O.

The authors have read and agreed to the published version of the manuscript.

Appendix 1

Table 5. Description of variables used in the models

Variable name	Variable symbol	Source
Income Inequality	S80/S20	World Income Inequality Database
GDP Per Capita	GDPpc	World Bank Database
Population	POP	World Bank Database
Climate Vulnerability	Vulnerability	Notre Dame Global Adaptation Initiative (ND-GAIN) Database
Terms of Tade	TOT	World Bank Database
Inflation	CPI	World Bank Database
GDP Growth	GDP	World Bank Database
Financial Globalization Index	KOF	KOF Swiss Economic Institute Database
Age Dependency	AGE Dependency	World Bank Database
Population Density	DENSITY	World Bank Database
Climate Resilience	Readiness	Notre Dame Global Adaptation Initiative (ND-GAIN) Database

Table 6. Summary statistics for high income countries

Variables	Observation	Mean	Median	S.D.	Min	Max
l_GDPpc	1820	10.1	10.3	0.733	8.17	11.6
l_s80s20	1790	1.70	1.64	0.378	1.06	3.37
l_Valnurebility	1256	-3.47	-3.49	1.31	-7.83	-1.53
l_Readiness	390	-2.47	-2.25	0.827	-7.65	-1.23
l_POP	1820	16.0	15.9	1.48	12.5	19.6
L_DENSITY	1787	4.42	4.60	1.49	0.855	8.99
l_TOT	1716	4.61	4.60	0.184	3.92	5.41
CPI	1731	4.38	2.10	29.2	-9.7	913.2
GDP	1731	2.79	2.78	3.37	-14.8	25.2
KOF	1769	78.1	79.6	8.05	49.1	90.9
AGE Dependency	1768	0.653	0.649	0.0687	0.481	0.931

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Table 7. Summary statistics for low and lower-medium income countries

Variables	Observation	Mean	Median	S.D.	Min	Max
l_S80s20	1790	2.18	2.14	0.487	0.993	4.38
l_GDPpc	1820	7.15	7.21	0.764	5.39	9.12
l_POP	1820	16.2	16.3	1.75	11.3	21.0
Density	1787	4.10	4.16	1.22	0.391	7.14
l_Valnurebility	1256	-2.89	-2.75	0.910	-9.39	-1.55
Readiness	1768	-3.87	-3.67	1.37	-10.6	-1.90
l_ToT	1716	4.71	4.65	0.312	3.06	5.77
CPI	1731	15.2	6.22	127	-27.0	4800.5
GDP	1731	3.99	4.40	4.84	-46.1	35.2
KOF	1769	46.8	46.3	10.3	22.4	74.8
AGE Dependency	1768	77.8	80.9	17.3	41.0	115

Robustness test

Table 8. The impact of climate change and income inequality in high income countries

	Model OLS(5)		Model OLS(6)	
	coefficient	p-value	coefficient	p-value
const	-1.305	0.004***	-1.215	0.135
GDPpc_1	0.048	0.08*	0.049	0.122
CPI_1	-0.006	0.182	-0.006	0,201
GDP_1	0.008	0,1116	0.008	<0,0001***
POP_1	0.03	0.008***	0.024	0.003***
Density_1	0.02	0.009***	0.02	0.015**
Valnurebility_1	0.021	0.188	0.022	0.353
TOT_1	0.493	<0.0001***	0.493	<0,0001***
AGE Dependency_1	1.684	<0.0001***	1.629	0,002***
KOF_1	0.006	0.104	0.05	0.361
Readiness_1			0.04	0.898
R-square	0,66		0,65	
No. of observation	85		85	

Dependent variable (Y): Income inequality – as measured by logarithm of the GINI index for disposable income; variables: GDPpc, POP, Density, Vulnerability, TOT, Readiness are logarithmized; all independent variables are lagged; there is no country and year fixed-effect; ***, **, * – statistical significance at the level of 1%, 5% and 10% threshold, respectively; standard errors (robust HAC).

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Table 9. The impact of climate change and income inequality in low and lower-medium income countries

	Model OLS(7)		Model OLS(8)	
	coefficient	p-value	coefficient	p-value
const	3.279	<0.0001***	3.291	<0.0001***
GDPpc_1	0.064	<0.0001***	0.063	<0.0001***
CPI_1	0.0004	0.0007***	0.0004	0.0010***
GDP_1	-0.0005	0.506	-0.004	0.559
POP_1	0.007	<0.0001***	0.007	<0.0001***
Density_1	-0.117	<0.0001***	-0.172	<0.0001***
Valnurebility_1	0.221	0.0002***	0.228	0.0001***
TOT_1	-0.033	<0.0001***	-0.036	<0.0021***
AGE Dependency_1	0.002	<0.0001***	0.001	0.0301**
KOF_1	-0.001	0.0006***	-0.001	0.0002***
Readiness_1			-0.089	0.146
R-square	0.11		0.12	
No. of observation	1452		1452	

Dependent variable (Y): Income Inequality – as measured by logarithm of the GINI index for disposable income; variables: GDPpc, POP, Density, TOT, are logarithmized; all independent variables are lagged; there is no country and year fixed-effect; ***, **, * – statistical significance at the level of 1%, 5% and 10% threshold, respectively; standard errors (robust HAC).

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WPŁYW ZMIAN KLICZMATYCZNYCH NA NIERÓWNOŚCI DOCHODOWE. IMPLIKACJE DLA BOGATYCH I BIEDNYCH KRAJÓW

STRESZCZENIE: Celem artykułu jest przedstawienie dowodów na związek między nierównościami dochodowymi a zmianami klimatycznymi zarówno w gospodarkach rozwiniętych, jak i o niskich dochodach. W niniejszym badaniu zastosowano metodę analizy opisowej wraz z analizą danych panelowych w celu oceny wpływu zmian klimatycznych na nierówności dochodowe w 42 krajach wysoko rozwiniętych i 68 krajach rozwijających się w latach 1995-2020. Wyniki badań empirycznych potwierdzają, że zmiany klimatyczne są ważnym czynnikiem odpowiedzialnym za rosnące nierówności dochodowe. Wpływ wrażliwości klimatycznej kraju na zagrożenia jest pozytywnie powiązany ze wzrostem nierówności dochodowych w gospodarkach o niskich dochodach. Z kolei odporność klimatyczna ma statystycznie istotny wpływ na rozkład dochodów w obu grupach, choć zdolność do łagodzenia i adaptacji do zmian klimatycznych jest znacznie słabsza w krajach rozwijających się. Badanie to podnosi naszą świadomość na temat powiązań między gospodarką a zmianami klimatycznymi, w tym ich konsekwencji dla nierówności dochodów, a także sygnalizuje możliwe zmiany w systemie redystrybucji w celu łagodzenia zmian klimatycznych i zwalczania nierówności dochodowych. Wartością dodaną tego artykułu są wyniki badań nad negatywnymi konsekwencjami zmian klimatycznych dla nierówności dochodowych w ponad 100 krajach. Szczególną uwagę zwrócono na kwestię etyczną nierównej odpowiedzialności za powodowanie zmian klimatycznych między krajami bogatymi i biednymi.

SŁOWA KLUCZOWE: zmiany klimatyczne, nierówności dochodowe, wzrost gospodarczy

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