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Interrelations between Income Inequality and Sustainable Economic Growth: Contradictions of Empirical Research and New Results

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Abstract: The idea that high levels of economic inequality negatively affect the rate and sustainability of economic growth is quite popular in the scientific literature. Therefore, it is usually proposed to take some regulative measures to reduce economic inequality in order to boost economic growth. Should the thesis be considered as a populist slogan or a scientifically proven fact? This article analyzes the results of 22 empirical studies on the relationship between economic inequality and economic growth conducted during the period of 1917–2018. We used meta-analysis to examine and systematize the results of previous empirical studies. The literature review and the analysis of the results from previous studies mainly indicate a negative relationship between economic inequality and economic growth (59% of the previous empirical research). The research gap is that on average these studies are rather controversial to each other and we cannot say that we understand these relationships correctly. To answer the questions concerning the interrelations between income inequality and sustainable economic growth, we made our own empirical research. To do this we used a qualitative pairwise correlation comparison method and analyzed panel data of 39 countries for the period of 1980–2019. The correlation between income inequality and sustainable economic growth was evaluated basing on the Gini index (GI) and Gross Domestic Product (GDP). Our calculations and analysis show that on average, in approximately 57.8% of moments in the period between 1980–2018, this correlation was positive in our sample of countries. The novelty of our study is that we show in detail how income inequality and economic growth are interconnected for each particular country and on average for the whole sample of countries. In addition, we used the inequality transparency index to adjust our calculations for data quality. Three hypotheses were tested in the study. Only one of them was confirmed by our research. The level of income inequality determines the direction of its impact on economic growth. An increase in income inequality in countries with low levels of inequality in most cases boosts economic growth and vice versa. Additionally, we received partial confirmation of our other hypothesis and found out that the correlation between economic growth and income inequality is definitely more negative for countries with low income and more positive in countries with high income per capita.

Keywords: economic inequality; income inequality; poverty; economic growth; progressive taxes; government financial regulation; Gini index; GDP; sustainable growth

1. Introduction

The relationship between economic inequality and economic growth is highly debatable (Kapeliushnikov 2017; Novokmet et al. 2018). There is great variety of opinions in the theoretical and empirical articles and the absence of any scientific consensus on this issue.

One group of researchers insists that the correlation between economic inequality and economic growth exists and has a negative value (Bertola 1993; Alesina Alberto 1994; Persson and Tabellini 1994; Perotti 1996; Benabou 1996; Fershtman et al. 1996; Checchi et al. 1999; Hassler et al. 2007; Michálek and Ján 2018). Higher levels of economic inequality will

probably negatively affect economic growth, become a source of socio-economic instability, restrict investments in human capital, slow down technological development etc. The other group of authors argue that rising economic inequality can accelerate economic and technological growth as well, because a high level of economic inequality encourages households to improve their education and take higher financial risks (Mirrlees 1971; Lazear and Rosen 1981; Bourguignon 2004).

The problem of assessing the relationship between income inequality and economic growth is that the orientation of the relationships under study is not clear. The results of numerous empirical studies of this problem do not give us an unequivocal answer as to whether this relationship is positive or negative. This fact complicates the development of an effective government policy for combating income inequality, since these regulations can both accelerate and slow down economic growth.

In the long-term perspective, a high level of economic inequality can lead to political, social and economic shocks. Social and political instability poses risks for investors, complicates legislative reforms aimed at protecting the rights of economic agents. From this point of view, economic inequality can indeed be a factor in technological slowdown and even economic recession in a country (Dorofeev 2021b).

Economic inequality can become a destabilizing factor for a financial system if low-income households use credit as the main way to improve their standard of living and thoughtlessly use it to finance current consumption (Varsavsky 2016; Kapeliushnikov 2017; Ponkratov et al. 2018; Osipov et al. 2020; Yuzvovich et al. 2020). The availability of loans in periods of low interest rates motivates households to increase their level of indebtedness, which leads to the creation of debt bubbles.

The subject of this research is income inequality and its interrelations with sustainable economic growth. At the same time, the term economic inequality appears in the main text of this research quite often. Economic inequality is a broader concept and includes income and wealth inequality (Dorofeev 2020). The focus of our study is concentrated on income inequality because this particular type of economic inequality represents the problem of household differentiation in current financial flows. Income inequality is a key factor, which influences on the level of household wealth inequality. In this regard, understanding the impact of income inequality on economic growth as a type of economic inequality is very relevant. Basing upon the results of the literature review, we propose the following research hypotheses:

Hypothesis 1 (H1). *There is a negative relationship between economic growth and income inequality.*

Hypothesis 2 (H2). *Correlation between economic growth and income inequality is negative in countries with low income and positive in countries with high income per capita.*

Hypothesis 3 (H3). *The critical level of income inequality determines the direction of its impact on economic growth. An increase in income inequality in countries with low levels of inequality in most cases boosts economic growth and vise a versa.*

The research question is concentrated on reassessment of interrelations between income inequality and sustainable economic growth. The main part of the research consists of 4 sections: (1) literature review, where we systematized the results of 22 previous empirical results; (2) materials and methods, where we describe in detail the methodological approach to our own empirical research; (3) the results of our study with evaluations of the correlation between economic inequality and economic growth; and (4) discussion, where we discuss the results and compare them with the research of other authors.

2. Literature Review

2.1. Theoretical Aspects of Interrelations between Economic Growth Economic Inequality

A review of the theoretical literature shows that rising economic inequality can have a negative impact on economic growth in the following cases:

1. A high level of economic inequality is not acceptable to the majority of voters. The majority of households vote for changes in the taxation system and increasing the rigidity of financial regulation. These actions in general are contrary to business interests and in most cases will reduce private consumption and investment (Bertola 1993; Alesina Alberto 1994; Persson and Tabellini 1994; Perotti 1996). At the same time, we cannot claim that this logic works equally in any context and country, because of political, social, economic and other intercountry differences.

2. Market inefficiency, low financial literacy of low-income households and deficit of financial resources for investment leads to underinvestment in the economy and the decrease in the GDP growth rate (Fershtman et al. 1996; Checchi et al. 1999; Hassler et al. 2007; Mirrlees 1971; Lazear and Rosen 1981). The lack of educational opportunities for households in emerging countries with low per capita income causes actual GDP growth to deviate from its optimal values. At the same time, innovations and technological progress make education cheaper and create new educational opportunities for all households, making education much more available as a public good.

3. Economic inequality can reduce fertility and negatively affect economic growth for obvious reasons (Perotti 1996).

4. A country with a high level of economic inequality in most cases will technologically progress much slower if this growth requires substantial domestic solvent demand from its residents. Lack of innovations and slow technological development of a country leads to a lag in economic growth from other countries (Acemoglu and Robinson 2012; Mikhaylov 2021; Mutalimov et al. 2021).

There is also an opposite view that rising economic inequality may accelerate economic growth for the following reasons:

1. A high level of economic inequality encourages households to improve education, increase productivity and work harder. Additionally, economic agents take higher risks in order to generate more income from their investments (Mirrlees 1971; Lazear and Rosen 1981).

2. Economic inequality increases the rate of saving and the rate of capital accumulation of wealthy households. According to the concept Triangle of F. Bourguignon (2004) and the World Bank (2006), the growth of economic inequality from a low base can lead to an acceleration of economic growth due to the increasing investments of wealthy households. On the other hand, a restrictive government's redistribution financial policy may slow down economic growth and innovations.

2.2. The Review of Empirical Studies on the Impact of Economic Inequality on Economic Growth

Dynamic and innovative economic growth can be reached when the government gives more economic freedom to corporates and households (Acemoglu and Robinson 2012). At the same time, in most cases, such economic growth and innovative development increase the level of economic inequality (Alesina Alberto 1994; Clarke 1995; Dorofeev 2020).

A high level of income inequality in most cases is a feature of nondemocratic regimes. Countries with high income inequality usually have a relatively poor level of political and economic institutes. Even if the institutional structure of such a country is good enough, it may not work as well as in democratic regimes (Zhuang et al. 2010; Kosov et al. 2018; Kosov et al. 2019; Sulemana and Kpienbaareh 2018; Dwijendra et al. 2021). Furthermore, an excessive level of income inequality can degrade the institutional structure of an economy, even in democratic countries and slow down economic growth (Policardo and Carrera 2018; Kotschy and Sunde 2016; Batabyal and Chowdhury 2015; Berisha et al. 2018). Thus,

income inequality is a key determinant of whether the quality of an economy's institutional structure will be the basis for sustained economic growth or not.

In this section, we reviewed and systematized key information about the research, authors, methods, materials and results of 22 empirical research studies concerning the interrelations between income inequality and economic growth (Table 1).

Table 1. Meta-analysis of the empirical research of the interrelations between income inequality and economic growth.

| Group of Research | Research Materials and Methods | | Results * | Comments |
	Authors and General Information about the Research	Data Coverage (years)		
1	2	3	4	5
GROUP 1. Type: income inequality. Indicators: Gini index.	Authors: Li and Zou (1998). Materials: 46 countries for the period 1960–1990. Panel data from the Deininger and Squire database. Methods: Econometric models with random (RE) and fixed effects (FE).	30	All = 1 HIC = n/a LIC = n/a	Positive correlation across the sample.
	Authors: Forbes (2000). Materials: 31/60 countries for the period 1966–1990. Panel data from the Deininger and Squire database. Methods: Generalized method of moments (First-diff GMM).	24	All = 1 HIC = 1 LIC = n/a	Positive correlation across the sample and in countries with high and middle income per capita.
	Authors: Barro (2000). Materials: 84 countries for the period 1965–1995. Panel data from the Deininger and Squire database. Methods: The method of three-step least squares (3SLS).	30	All = 0 HIC = 1 LIC = −1	Little impact of inequality on growth and innovations across the sample. Positive correlation in countries with high income and negative for countries with low income per capita.
	Authors: Banerjee and Duflo (2000). Materials: 45 countries for the period 1965–1995. Panel data from the Deininger and Squire database. Methods: Regression analysis.	30	All = −1 HIC = n/a LIC = n/a	Negative correlation of inequality with economic growth and innovations.
	Authors: Knowles (2005). Materials: 40 countries for the period 1960–1990. Cross-sampling from the Deininger and Squire base. Methods: The method of least squares (OLS).	30	All = −1 HIC = 0 LIC = 1	Negative correlation across the whole sample. Neutral correlation for high-income and middle-income countries. Negative correlation for low-income countries.
	Authors: Halter et al. (2014). Materials: 90 countries for the period 1966–2005. Panel data from the databases "Deininger and Squire" and "WIID—World Income Inequality Database." Methods: Generalized method of moments (System generalized method of moments GMM, First-diff GMM).	39	All = 1 HIC = 1 LIC = −1	Positive correlation across the whole sample. and its individual elements. System GMM method showed a positive correlation across countries with high income and a negative correlation across countries with low income per capita.

Group of Research	Research Materials and Methods		Results *	Comments
	Authors and General Information about the Research	Data Coverage (years)		
1	2	3	4	5
	Authors: Ostry et al. (2014). Materials: 91 countries for the period 1960–1990. Panel data from the SWIID database. Methods: Generalized method of moments (System GMM).	30	All = 1 HIC = n/a LIC = n/a	The negative correlation of inequality with and innovations and economic growth.
	Authors: Tridico and Meloni (2018). Materials: 34 countries for the period 1990–2013. Panel data from the Organisation for Economic Co-operation and Development (OECD) database. Methods: The generalized least squares (GLS) method and the generalized moment method (GMM).	23	All = −1 HIC = n/a LIC = n/a	The negative correlation between inequality and economic growth.
GROUP 2. Type: income inequality. Indicators: fourth quintile of households by income level.	Authors: Persson and Tabellini (1994). Materials: 56 countries for the period 1960–1985. Cross-sampling from the Paukert base. Methods: Three-step least squares method (OLS, 2SLS).	25	All = −1 HIC = n/a LIC = n/a	Negative correlation between inequality and economic growth for the whole sample. Negative correlation for democratic countries and neutral for nondemocratic ones.
GROUP 3. Type: income inequality. Indicators: Gini index; Tale index; fourth household income quintile.	Authors: Clarke (1995). Materials: 74/81 countries for the period 1970–1978. Cross sample from the UN Social Indicators base. Methods: Three-step least squares method (OLS, 2SLS).	8	All = −1 HIC = n/a LIC = n/a	Negative correlation between inequality and economic growth for the entire sample, including for democratic and undemocratic countries.
GROUP 4. Type: income inequality. Indicators: third and fourth household income quintile.	Authors: Perotti (1996). Materials: 67 countries for the period 1960–1985. Cross sample from the Jain Lecaillon base. Methods: Three-step least squares method (OLS, WLS).	25	All = −1 HIC = −1 LIC = 0	Negative correlation between inequality and economic growth for the entire sample, including for democratic and undemocratic countries. Became neutral when adding regional correction variables to the regression model. Negative for countries with high income and neutral in countries with low income per capita.
GROUP 5. Type: income inequality. Indicators: Gini index; 90/75 and 50/10 percentile groups ratios.	Authors: Voitchovsky (2005). Materials: 21 developed countries for the period 1975–2000. Panel data from the database Luxembourg Income Study. Methods: Generalized method of moments (System GMM).	25	All = 0 HIC = 1 LIC = −1	Neutral correlation for the whole sample. Positive for high-income countries and negative for countries with low income per capita.

Table 1. *Cont*.

Group of Research	Research Materials and Methods		Results *	Comments
	Authors and General Information about the Research	Data Coverage (years)		
1	2	3	4	5
	Authors: Alesina Alberto (1994). Materials: 46–70 countries for the period 1960–1985. Cross-sampling from the Jain Fields base. Methods: Three-step least squares method (OLS, 2SLS).	25	All = −1 HIC = n/a LIC = n/a	1. Income: negative correlation for the entire sample (both for democratic countries and for undemocratic countries). 2. Land: Negative correlation for the entire sample. 3. Neutral when assessing correlation taking into account both income and land factors.
GROUP 6. Type: inequality in income and land assets. Indicators: Gini index.	Authors: Deininger and Squire (1998). Materials: 66/87 countries for the period 1960–1992. Cross-sampling from the Deininger and Squire base. Methods: Method of the least squares (OLS).	32	All = −1 HIC = 0 LIC = −1	1. Income: negative correlation for the whole sample. Neutral when adding regional correction variables to the regression model. 2. Land: Negative correlation for the entire sample. Little dependence in democratic countries and negative in nondemocratic countries. Little dependence in countries with high income and negative in countries with low income per capita.
	Authors: Deininger and Olinto (2000). Materials: Materials and methods: 31/60 countries for the period 1966–1990. Panel data from the Deininger and Squire database. Methods: Generalized method of moments (System GMM).	24	All = 1 HIC = n/a LIC = n/a	1. Income: positive correlation with the simultaneous use of land and income factors. 2. Land: the negative correlation of the land inequality and economic growth.
	Authors: Fawaz et al. (2014) Materials: Materials and methods: 55 low-income developing countries and 56 high-income developing countries for the period 1960–2010. Panel data from World bank database. Methods: Generalized method of moments (System GMM).	50	All = n/a HIC = 1 LIC = −1	Strong evidence of a negative relationship between income inequality and economic growth in low-income developing countries and a positive inequality–growth relationship for high-income developing countries.
GROUP 7. Type: inequality in income and human capital. Indicators: Gini index.	Authors: Castelló-Climent and Rafael (2002). Materials: 67/83 countries for the period 1960–1990. Cross-sampling from the such databases as Deininger and Squire, Barro and Lee. Methods: The least squares method (OLS).	30	All = −1 HIC = n/a LIC = n/a	1. Income: negative correlation for the entire sample of countries. Neutral when adding regional correction variables to the regression model. 2. Human capital: negative correlation for the whole sample.

Table 1. *Cont.*

Group of Research	Research Materials and Methods		Results *	Comments
	Authors and General Information about the Research	Data Coverage (years)		
1	2	3	4	5
GROUP 8. Type: inequality in income and human capital. Indicators: Gini index; distribution of education factor by quintile.	Authors: Castelló-Climent (2010). Materials: 102–56 countries for the period 1960–2000. Panel data from the base UNU-WIDER Luxembourg Income Study. Methods: Generalized method of moments (System GMM).	40	All = −1 HIC = 1 LIC = −1	1. Income: Negative correlation for the entire sample of countries. Negative correlation for countries with low income per capita and positive for countries with high income per capita. 2. Human capital: Negative connection for the entire sample of countries. Negative for poor countries and ambiguous for rich countries.
GROUP 9. Type: inequality in income, land assets and human capital. Indicators: Gini index; distribution of education factor by quintile.	Authors: Birdsall and Londono (1997). Materials: 43 countries for the period 1960–1992. Cross-sampling from the Deininger and Squire base. Methods: The least squares method (OLS).	32	All = −1 HIC = n/a LIC = n/a	1. Income: negative correlation for the whole sample. 2. Land: Negative correlation for the entire sample. 3. When evaluating dependencies based on all factors simultaneously, the correlation becomes insignificant.
GROUP 10. Type: income inequality; human capital; wealth (physical assets). Indicators: Gini index; fund ratios (share of the average income of the 2nd and 9th decile groups).	Authors: Cingano (2014). Materials: 31 developed countries from the OECD group (a specially selected sample of countries to eliminate the distorting factor of country characteristics) for the period 1970–2010. Panel data from the OECD Income Distribution Dataset (IDD) database. Methods: The generalized method of moments (System GMM).	40	All = −1 HIC = n/a LIC = n/a	Negative correlation for the entire sample. Reducing inequality at the bottom of the distribution has a greater effect on accelerating economic growth than at the top. Antipoverty policies are essential to sustainable economic growth and innovations.
GROUP 11. Type: income inequality. Indicators: Real GDP per capita in the USA; Gini, Tale and Atkinson indexes; shares of income groups (top 10% and 1%).	Authors: Chang et al. (2018). Materials: USA (one country) for the period 1917–2012. Panel data from Mark W. Frank database. Methods: Wavelet analysis methods; analysis of inequality cycles and volatility of economic growth; Monte Carlo simulations and analysis of the causal relationship between inequality and economic growth.	96	All = 1 HIC = n/a LIC = n/a	High positive correlation between income inequality and economic growth. Income inequality affects the dynamics of real GDP and innovations, and not vice versa. The authors warn that overregulation and the use of excessively restrictive policies to combat income inequality may slow economic growth.

Table 1. *Cont.*

Group of Research	Research Materials and Methods		Results *	Comments
	Authors and General Information about the Research	Data Coverage (years)		
1	2	3	4	5
GROUP 12. Type: income and wealth inequality. Indicators: Gini, Tale and Atkinson indexes; shares of different income groups and wealth groups (bottom 50%, average 40%, top 10%, 5%, 1%, 0.5%, 0.1% and 0.01%).	Authors: Chang et al. (2019). Materials: USA (one country) for the period 1917–2015. Panel data from the World Inequality Database, as well as the Mark W. Frank Database. Methods: Wavelet analysis methods; analysis of inequality cycles and volatility of economic growth; Monte Carlo simulations and analysis of the causal relationship between inequality and economic growth.	98	All = 1 HIC = n/a LIC = n/a	High positive correlation between income inequality and economic growth. Periodically, inequality affects the volatility of economic growth, and sometimes vice versa. The higher the volatility of economic growth, whether it's a recession or an economic boom, the more it affects inequality. Authors recommend to use progressive tax systems, raising marginal tax rates for the rich and lowering them for the poor, as well as using more tools to stabilize economic growth that will reduce its volatility and positively affect inequality.

Source: Compiled by the author based on (Alesina Alberto 1994; Persson and Tabellini 1994; Clarke 1995; Perotti 1996; Deininger and Squire 1996, 1998; Birdsall and Londono 1997; Li and Zou 1998; Forbes 2000; Barro 2000; Banerjee and Duflo 2000; Knowles 2005; Voitchovsky 2005; Halter et al. 2014; Ostry et al. 2014; Fawaz et al. 2014; Deininger and Olinto 2000; Castelló-Climent and Rafael 2002; Castelló-Climent 2010; Cingano 2014; Chang et al. 2018, 2019). * Notes: All—all sample of countries; HIC—group of countries with high income per capita; LIC—group of countries with low income per capita.

We used s meta-analysis method to summarize all relevant data from the previous empirical studies. This research of empirical studies showed a very large spread of results. We would like to point out some details and findings from the meta-analysis of the data from Table 1.

The results of the research are highly dependent on the composition of the country sample groups. We also identified that the result of the analysis of the correlation between economic inequality and growth is sensitive to methods and a set of indicators of economic inequality.

Authors used very different metrics of economic inequality in their research. A choice of the Gini index as a proxy for income inequality is very popular. In the latest research, authors started to use a wide range of different income inequality metrics. In most cases, it was a combination of different ratios and indexes. Indeed, the use of special econometric software makes it easier to do more complicated calculations of correlational-regression analysis. At the same time, this shift to complexity can be explained with another fact. After approximately 2000, the overall picture with accumulated results of the empirical research became very mixed. This factor also motivates the researchers to seek new approaches and methods to clarify the correlation between variables.

All studies prior to 1998 show a negative relationship between variables. Research dating between 1998 and 2000 showed a positive correlation between economic inequality and economic growth. In the next series of studies, made in the period 2002–2010, authors wrote that in most cases economic inequality has a negative correlation with economic growth and innovations. The only exception was the research of Voitchovsky (2005), where the author identified a neutral correlation. After that, in 2014 there was another study, which again revealed a positive correlation between economic inequality and economic

growth. In the most recent papers, where the authors used the method of wavelet analysis and the data concerning only the one country (USA), unambiguous results were obtained. Authors found a high positive correlation between income inequality and economic growth in the USA.

The informational base which was used in the reviewed empirical research has different sources and varies in time between 1917–2018 YY. Some authors decided to use only one database for their research. For example, Tridico and Meloni (2018) used OECD data, Ostry et al. (2014) used the SWIID database, Voitchovsky (2005) used panel data from the Luxembourg Income Study database etc. At the same time, we can see, that there were also authors who collected data from different sources. The latest research carried out by Chang et al. (2019) was made with the use of panel data from the World Inequality database and Mark W. Frank database (column 2 of Table 1).

The average data coverage in the reviewed studies is about 28.5 years. The minimum period of analysis covers 8 years. The maximum data coverage (40 years) for a multicounty sample was implemented in the studies of Castelló-Climent (2010), Halter et al. (2014) and Cingano (2014). The increase in the temporal coverage of the data did not clarify the correlations between inequality, innovations and growth. The research of Chang et al. (2019) covered 98 years of data for the US. Research of a single-country sample data is probably making the result more determined. For the US, this is a strong positive correlation between variables.

To understand the nature of the correlation between economic growth and income inequality, the researchers used methods such as: different specifications of the method of least squares, method of moments and method of wavelet analysis (column 2 of Table 1).

In 7 of the 22 studies from the literature review section (31.8% of the sample), in addition to the analysis of the whole sample of countries, authors also classified countries into the several groups: (1) "country with developed/developing economy"; (2) "country with high/low income per capita"; and (3) "country with a democratic/nondemocratic political system". Dividing the sample of countries into the groups also showed contradictory results in the analysis of the interrelation between economic inequality and economic growth. The overall conclusions obtained from the analysis of the full sample differ from the results concerning country subgroups.

We analyzed the research by date and found no significant relationship between the date and the results of a study. Earlier studies were conducted by different variations of the method of least squares with the use of data from the period of 1960–1990. In later articles (after 2000s), authors began to use the generalized method of moments and the spread of results between different research increased. By 2018, the overall picture became confusing, as it was supplemented by a significant number of works with mixed and positive correlation between inequality and growth. These new results raised reasonable doubts that the thesis of a negative correlation between economic inequality and growth is undeniable and a correct one.

3. Materials and Methods

After conducting a detailed literature review, we have: plenty of different results, obtained with the use of various methods of classical correlation analysis and very little understanding of what the relationships between the variables under study are. This is the key reason as to why we decided to choose the other method for the research, which as more suitable to research our problem. To analyze interrelations between inequality and growth we used a qualitative pairwise correlation comparison method, which allows us to make a step-by-step analysis of the relationships between changes in inequality and economic growth in each country from our sample.

The methodology of the qualitative pairwise correlation comparison method is closely related to graphical (trend) analysis and intends step-by-step paired comparisons of changes in variables under study by year. This method does not determine coefficients of correlation as it is usually performed in a classical correlation analysis methodology and this is its

disadvantage. At the same time, this method allows us to qualitatively evaluate the correlation between inequality and growth in the format «1/0» or «yes/no». With the use of this method, we succeeded inbuilding a heatmap of simple year-by-year correlations between our variables (Appendix A).

Vertical analysis of data with the use of a qualitative pairwise correlation comparison method focuses on the research of relationships between changes in inequality and economic growth by year (Appendix A).

Horizontal analysis of data with the use of a qualitative pairwise correlation comparison method allows us to examine relationships between changes in income inequality and economic growth by country (Table 1).

The study was conducted using data on income inequality and economic growth in 37 countries for the period between 1980–2018 (38 years).

Income inequality was measured by the Gini index, calculated on the basis of market income of households (World Inequality Database 2020). In order to adjust the results of our calculations for the quality and availability of income inequality data in different countries, we also used an indicator such as the inequality transparency index (World Inequality Database 2020). Economic growth was measured as GDP growth in percentage points (World Bank 2021).

The Gini index (GI) has a number of advantages, because of which it is widely used in many research studies to characterize the level of income inequality. The advantages of GI are: (1) relative dimension, independence from the sample size and the level average income; (2) symmetry; (3) sensitivity to the Pygo–Dalton income distribution principle, etc. (Castagnoli and Muliere 1990; Bosmans et al. 2009; An et al. 2021). This indicator is most informative when used together with the Lorentz curve.

However, the main disadvantage of GI is the difficulty of its decomposition for assessing the nature of income distribution between sample percentile groups (Keeley 2015). That is why this indicator is often used together with others, such as the percentile income groups of top income distribution (0.01%; 0.1%; 1%; 3%; 5% and 10% top income earners of a country); Decile ratio; Quintile ratio; Palm ratio; Theil index, etc. (World Inequality Report 2018, P. 29; Dorofeev 2021a).

Despite all the disadvantages of the GI, it was widely used in 22 research studies, which we reviewed and discussed in Section 1. Thus, we decided to use this metric in our research to get comparable results.

To test the hypothesis H3, we divided our sample into quartiles by the Gini index. The 1st quartile includes a group of countries with the lowest level of income inequality. These are mainly developed countries from the European Union with high income per capita. The 4th quartile in general includes a group of countries with the highest level of income inequality from our sample and represents developing countries with low and middle income per capita.

4. Results

The results of a vertical analysis of the data with the use of a qualitative pairwise correlation comparison method are shown in Appendix A in Tables A1–A4. They represent a heatmap of the correlation between income inequality and economic growth and can be useful for conducting year-by-year analysis.

The number "0" in Tables A1–A4 demonstrates the absence of correlation and shows the years where one of our variables changes and the other do not. The number "2" indicates the years when income inequality and economic growth go up simultaneously and have a positive correlation. The number "−2" represents the years when variables are declining and have a positive correlation.

The results of a horizontal analysis of income inequality and growth with the use of a qualitative pairwise correlation comparison method is shown in Table 2. This data will help us to test the underlying hypotheses of our research.

Table 2. The results of a horizontal analysis of income inequality and economic growth with the use of a qualitative pairwise correlation comparison method.

Q[1]	No.	Country	Income Inequality. GI, 2019	Number of Observations (Total). Years	Number of Years with Positive Correlation and Growth of Variables		Number of Years with Positive Correlation and Decline of Variables		Number of Years with Positive Correlation of Variables (Total)		Number of Years with Negative Correlation of Variables		Inequality Trans-Parency Index
		1	2	3	4	5 = 4/3 (%)	6	7 = 6/3 (%)	8 = 4+6	9 = 8/3 (%)	10 = 3–8	11 = 10/3 (%)	12
IV	1	South Africa	0.746	29	10	34.5%	5	17.2%	15	51.7%	14	48.3%	8.5
	2	Central African Republic	0.733	37	6	16.2%	13	35.1%	19	51.4%	18	48.6%	1.0
	3	Mexico	0.697	38	7	18.4%	11	28.9%	18	47.4%	20	52.6%	8.5
	4	Brazil	0.689	38	7	18.4%	3	7.9%	10	26.3%	28	73.7%	5.5
	5	Chile	0.687	37	10	27.0%	11	29.7%	21	56.8%	16	43.2%	8.0
	6	Sub-Saharan Africa	0.675	38	8	21.1%	19	50.0%	27	71.1%	11	28.9%	0.0
	7	WORLD	0.663	38	10	26.3%	11	28.9%	21	55.3%	17	44.7%	-
	8	India	0.634	38	19	50.0%	6	15.8%	25	65.8%	13	34.2%	4.0
	9	Qatar	0.624	18	3	16.7%	7	38.9%	10	55.6%	8	44.4%	-
	10	Turkey	0.583	37	9	24.3%	15	40.5%	24	64.9%	13	35.1%	3.0
III	11	USA	0.583	38	16	42.1%	10	26.3%	26	68.4%	12	31.6%	15.5
	12	Israel	0.574	38	9	23.7%	7	18.4%	16	42.1%	22	57.9%	3.0
	13	Uzbekistan	0.565	31	3	9.7%	6	19.4%	9	29.0%	22	71.0%	0.5
	14	China	0.555	38	14	36.8%	8	21.1%	22	57.9%	16	42.1%	6.5
	15	Russian Federation	0.549	29	9	31.0%	9	31.0%	18	62.1%	11	37.9%	4.5
	16	Bulgaria	0.540	38	9	23.7%	9	23.7%	18	47.4%	20	52.6%	5.5
	17	Canada	0.535	38	18	47.4%	11	28.9%	29	76.3%	9	23.7%	9.0
	18	Korea	0.530	38	17	44.7%	6	15.8%	23	60.5%	15	39.5%	10.5
	19	Indonesia	0.528	37	13	35.1%	11	29.7%	24	64.9%	13	35.1%	6.0
	20	Tajikistan	0.525	33	12	36.4%	7	21.2%	19	57.6%	14	42.4%	0.5
	21	Japan	0.520	38	18	47.4%	9	23.7%	27	71.1%	11	28.9%	6.0
II	22	Australia	0.497	38	14	36.8%	8	21.1%	22	57.9%	16	42.1%	9.0
	23	Kazakhstan	0.496	28	6	21.4%	8	28.6%	14	50.0%	14	50.0%	3.0
	24	Germany	0.490	38	10	26.3%	12	31.6%	22	57.9%	16	42.1%	10.0
	25	Estonia	0.481	25	7	28.0%	7	28.0%	14	56.0%	11	44.0%	9.0
	26	Poland	0.476	28	12	42.9%	4	14.3%	16	57.1%	12	42.9%	8.5
	27	Azerbaijan	0.467	28	12	42.9%	4	14.3%	16	57.1%	12	42.9%	1.0
	28	Ukraine	0.467	31	16	51.6%	4	12.9%	20	64.5%	11	35.5%	1.0
	29	Armenia	0.467	29	15	51.7%	5	17.2%	20	69.0%	9	31.0%	1.0
	30	Belarus	0.467	30	13	43.3%	3	10.0%	16	53.3%	14	46.7%	1.0
	31	Great Britain	0.466	38	10	26.3%	9	23.7%	19	50.0%	19	50.0%	15.5
	32	European Union	0.463	38	12	31.6%	7	18.4%	19	50.0%	19	50.0%	-
	33	New Zealand	0.459	38	11	28.9%	11	28.9%	22	57.9%	16	42.1%	10.5
I	34	Spain	0.456	38	13	34.2%	11	28.9%	24	63.2%	14	36.8%	10.0
	35	Italy	0.444	38	14	36.8%	9	23.7%	23	60.5%	15	39.5%	13.0
	36	Finland	0.441	38	17	44.7%	12	31.6%	29	76.3%	9	23.7%	10.5
	37	France	0.436	38	14	36.8%	10	26.3%	24	63.2%	14	36.8%	15.0
	38	Austria	0.427	38	8	21.1%	13	34.2%	21	55.3%	17	44.7%	10.0
	39	Netherland	0.419	38	15	39.5%	7	18.4%	22	57.9%	16	42.1%	9.5
	40	Slovenia	0.413	28	9	32.1%	6	21.4%	15	53.6%	13	46.4%	9.5
	41	Norway	0.409	38	13	34.2%	11	28.9%	24	63.2%	14	36.8%	16.5
	42	Sweden	0.392	38	15	39.5%	12	31.6%	27	71.1%	11	28.9%	14.5
	43	Maximum	0.746	38.00	19.0	51.7%	19.00	50.0%	29.00	76.3%	28.00	73.7%	16.50
	44	3rd quartile	0.580	38.00	14.0	41.4%	11.00	29.5%	24.00	64.2%	16.00	46.6%	10.00
	45	Average	0.530	34.88	11.5	32.9%	8.74	24.9%	20.24	57.8%	14.64	42.2%	7.28
	46	Median	0.509	38.00	12.0	34.2%	9.00	25.0%	21.00	57.9%	14.00	42.1%	8.50
	47	1st quartile	0.464	31.00	9.00	24.8%	6.25	18.4%	16.50	53.4%	12.00	35.8%	3.00
	48	Minimum	0.392	18.00	3.00	9.7%	3.00	7.9%	9.00	26.3%	8.00	23.7%	0.00
	49	Weighted average (by inequality transparency index) dependence of variables for all countries, including by quartile groups of income inequality:								59.7%		40.3%	
	50	4th quartile group (top 25%)								55.8%		55.8%	
	51	3rd quartile group (50% −75%)								62.0%		38.0%	
	52	2nd quartile group (25% −50%)								55.2%		44.8%	
	53	1st quartile group (lower 25%)								62.7%		37.3%	

Source: Compiled by the author based on (World Inequality Database 2020; World Bank 2021). [1] Income inequality quartile groups. Notes: We used a method of building heatmaps to highlight the level of indicators in this table. For column 2 "green" color means a low level of income inequality and "red" means the opposite. The general concept is "green" is better than "red" and "yellow" is an average. Also, we used a combination of "blue" and "red" colors for columns № 5, 7, 9, 11. In this case the concept is "blue" = "low level of indicator" and "red" = "high".

The next result is connected with the test of hypothesis H3 and the analysis of data in income inequality quartile groups (Table 3).

Table 3. The results of testing hypothesis H3.

Q	Country Quartile Group Statistics	Income Inequality. GI, 2019	% of Years with Positive Correlation of Variables	% of Years with Negative Correlation of Variables	Inequality Transparency Index
IV	Maximum	0.746	68.4%	73.7%	15.5
	Average	0.664	54.2%	45.8%	6.8
	Median	0.687	55.6%	44.4%	6.8
	Minimum	0.583	26.3%	31.6%	1.0
III	Maximum	0.574	76.3%	71.0%	10.5
	Average	0.542	56.9%	43.1%	5.2
	Median	0.537	59.2%	40.8%	5.8
	Minimum	0.520	29.0%	23.7%	0.5
II	Maximum	0.497	69.0%	50.0%	15.5
	Average	0.478	57.3%	42.7%	5.9
	Median	0.471	57.1%	42.9%	5.8
	Minimum	0.466	50.0%	31.0%	1.0
I	Maximum	0.459	76.3%	46.4%	16.5
	Average	0.430	62.2%	37.8%	11.9
	Median	0.431	61.8%	38.2%	10.5
	Minimum	0.392	53.6%	23.7%	9.5

Source: Compiled by the author based on (World Inequality Database 2020; World Bank 2021). Notes: We used a method of building heatmaps to highlight the level of indicators in this table. The concept is the following: "blue" is a low level of indicator and "red" is high.

5. Discussion

The literature review and the analysis of the results from previous studies mainly indicate a negative relationship between economic inequality and economic growth (see Table 1). According to 13 studies (59%) from our sample, economic inequality negatively affects economic growth. A positive relationship between variables under study was only found in six research studies (27.2%). No or a mixed correlation was found in the other two articles (13.6%). Therefore, most scientists argue that the growth of economic inequality has a negative impact on economic growth. Accordingly, governments should reduce economic inequality in order to accelerate economic growth. From our point of view, this thesis has some populist connotation, since even at the stage of the literature review of our research it became clear that the relationships between inequality and growth are not as simple and unambiguous as it may seem.

At the same time, our calculations and analysis show that on average in approximately 57.8% of moments in the period between 1980–2018 this correlation was positive in our sample of countries. Our findings are similar to the results of the research carried out by Li and Zou (1998); Deininger and Olinto (2000); Forbes (2000); Halter et al. (2014); Fawaz et al. (2014); and Chang et al. (2018, 2019).

Based on the results of our study, we believe that the relationship between income inequality and economic growth is predominantly positive. This means that for most countries, higher levels of income inequality would benefit their economic growth.

According to the results of previous research, a positive correlation between economic inequality and economic growth quite often occurs in countries with high income per capita. This means that the rise of income inequality in developed countries with high income per capita will benefit their economic growth. This thesis looks rather logical for countries with low levels of economic inequality, such as countries in Continental Europe.

A possible explanation for the phenomenon as to why economic inequality has a positive correlation with innovations and growth in countries with high income and a negative correlation in countries with low income is so called "critical level of economic inequality". In 2006, the World bank hypothesized that the Gini index (GI) = 0.4 is a

decisive level of economic inequality for economic growth (World Bank 2006). The increase in economic inequality in countries with high levels of economic inequality negatively affects growth and innovations. At the same time, the similar situation in developed countries with high income and relatively low levels of economic inequality can even accelerate economic growth and innovations.

Basing on the data from Table 2 and Appendix A, we can conclude that hypothesis H1 about a negative relationship between economic growth and income inequality is false. Their relationship varies from country to country and depends on different factors. For the sample of countries, it can be defined on average as more of a positive one. Some important details and implications are described below.

5.1. Vertical Qualitative Pairwise Correlation Comparison of Income Inequality and Economic Growth

The results of the analysis of data from Appendix A show that the proportion of countries with a positive correlation of the variables under study in the periods of economic growth in most cases varies between 50–65%.

The total number of countries with a positive correlation of inequality and growth increases during the periods of financial crises and economic recessions, mainly because of the decline in both income inequality and GDP.

During the years when the economy and stock markets were reaching their peaks before 2008, income inequality rose along with economic growth. The start of recessions and global economic crises usually reduced the degree of correlation between income inequality and economic growth. Approximately 1–2 years after a crisis both economic growth and income inequality began to move up in most countries.

The year of The Great Recession is unique. This period is the only one out of all points of observation where we can see in all countries, without exceptions, a positive correlation between the variables under study. Income inequality decreased simultaneously with the decline in economic growth. At the same time, during the previous crises, the overall picture was mixed and only in 45% of countries was there a negative relationship between income inequality and economic growth. Based on these findings, we believe that the results of our study will shift even more in favor of a positive correlation between income inequality and sustainable economic growth when we include the data of the next 2–4 years after 2019.

5.2. Horizontal Qualitative Pairwise Correlation Comparison of Income Inequality and Economic Growth

According to the data from the Table 2, the correlation between income inequality and economic growth varies from country to country. For the whole sample, this correlation (lines 45–46 of Table 1) is more positive (57.8%) than negative (42.2%). On average, it is more likely that rising income inequality in a country will be accompanied by an acceleration of economic growth, rather than by a slowdown of an economy. There is a certain skew in favor of a positive correlation between income inequality and economic growth.

Our findings confirm the idea that interrelations between inequality and growth is rather contradictory. It follows from Table 2 that there is no stable and unambiguous relationship between the variables under study.

The most significant positive correlation (top-7 positive correlation) between income inequality and economic growth was found in countries such as Finland (76.3%); Canada (76.3%); Sweden (71.1%); Japan (71.1%); Armenia (69.0%); USA (68.4%); and India (65.8%). These results correspond with findings in (Chang et al. 2018, 2019), where authors wrote about a strong positive correlation between economic inequality and growth in the United States.

The most significant negative correlation (top-7 negative correlation) between income inequality and economic growth was found in countries such as Brazil (73.7%); Uzbekistan (71.0%); Israel (57.9%); Mexico (52.6%); Bulgaria (52.6%); Kazakhstan (50%); and Great Britain (65.8%).

According to the data from Table 2, we can argue that hypothesis H2 is also false. We cannot say for definite that the correlation between economic growth and income inequality is negative in countries with low income and positive in countries with high income per capita. In fact, we can argue, that in both cases these relationships are mixed. At the same time, we can argue that on average this mixed picture of correlations is definitely more negative for countries with low income and more positive in countries with high income per capita. This result is a rather interesting finding and has a lot in common with the results in the research carried out by Fawaz et al. (2014).

5.3. Does Inequality Transparency Index Change the Overall Picture?

In addition to the general horizontal qualitative pairwise correlation comparison of income inequality and economic growth, we used the inequality transparency index in order to reassess averages (column 12 in Table 3). This work is also an important contribution in the research of this scientific area. We calculated new averages in lines 49–53 for the whole sample of countries and for each quartile income group weighted by the inequality transparency index. These adjustments did not significantly change the overall picture with variables correlation. The basic averages in the line 45 increased from 57.8% to 59.7% for a positive correlation and decreased from 42.2% to 40.3% for a negative correlation of variables.

We explain these changes with the fact that developed countries with high income per capita and lower levels of income inequality publish better quality information on inequality. Therefore, the adjustments of our calculations made the weighted average correlation a little bit more positive.

5.4. Analysis of Quartile Income Groups and Search of a Critical Income Inequality Level

First of all, we should point out that there are many different types of income inequality indicators, depending on the type of income which is used to calculate the Gini index (Dorofeev 2021a). The idea of a critical level of economic inequality, proposed by the World Bank, is rather interesting. We calculated general statistics for each quartile group in Table 3 and based on it, we can definitely say that the correlation between income inequality and economic growth indeed depends on the level of inequality in a particular country. The higher the income inequality is, the lower the average percentage of years with a positive correlation between variables under study is and vice versa. The percentage of years with a negative correlation between variables under study increases on average from 37.8% in the 1st quartile income inequality group (with the lowest income inequality) up to 45.8% in the 4th (with the highest income inequality).

Considering these findings, we can argue that the level of income inequality in a country has a significant influence on economic growth, so the hypothesis H3 is true.

The concrete critical level of income inequality in the GI measurement is highly dependent on the dataset and on the sample of countries which are used in the research. In our case, it is obviously higher than 0.4 GI of the World Bank. Based on the data of the market income of households from the World Inequality Database (2020), the critical level of income inequality is probably in the range of 0.47–0.55 by Gini index.

The results from this section and the previous ones give regulators some space for taking actions in reducing income inequality. This "60/40 correlation balance" means that a decline in income inequality will not necessarily lead to a slowdown in economic growth and innovations. Moreover, we should add that countries with high income inequality in general will benefit more than others from combating income inequality. At the same time, for countries with lower levels of income inequality, the majority of which are developed countries in Continental Europe, toughening fiscal policy for combating income inequality will probably generate negative outcomes for their economies. The regulators of countries with low income inequality should create more economic freedoms and stimulus for boosting economic growth and innovations.

Future development of this research may focus on expanding the information base and the use of other measures and indicators of economic inequality, innovations and economic growth (shares of the bottom 50%, the average 40% and the top 10% and 1% of households by market income, GDP per capita by purchasing power parity (PPP), etc.).

6. Conclusions

In this article, we researched the relationships between income inequality and economic growth. The review of results from 22 empirical studies formed a very mixed and contradictory picture. In 59% of them, authors found a negative relationship between economic inequality and economic growth. According to this picture, it is difficult to say for definite how income inequality affects sustainable economic growth, since there is empirical evidence of both positive and negative correlations of these variables.

To gain more clarity of the problem under study, we conducted our own study based on a qualitative pairwise correlation comparison method for a sample of 39 countries and utilized the research period from 1980 to 2018. Correlation between income inequality and sustainable economic growth was evaluated basing on the Gini index and GDP.

The original research solution is the use of a qualitative pairwise correlation comparison method which allowed us to make a step-by-step analysis of the relationships between changes in inequality and economic growth in each country from our sample. This method allowed us to qualitatively evaluate the correlation between inequality and growth in the format «1/0» or «yes/no». With the use of this method, we succeeded in building a heatmap of simple year-by-year correlations between our variables for each single country from our sample and calculated averages for the whole sample of countries (Table 1 and Appendix A).

Our calculations and analysis show that on average, in approximately 57.8% of moments in the period between 1980–2018, this correlation was positive in our sample of countries. The novelty of our study is that we show in detail how income inequality and economic growth are interconnected for each particular country and on average for the whole sample of countries. In addition, we used the inequality transparency index to adjust our calculations for data quality. The adjustment of our calculations with the use of the inequality transparency index had little effect on the results.

Three hypotheses were tested in the study. Only one of them was confirmed by our research. The level of income inequality determines the direction of its impact on economic growth. An increase in income inequality in countries with low levels of inequality in most cases boosts economic growth and vice versa. Additionally, we received a partial confirmation of our other hypothesis and found out that the correlation between economic growth and income inequality is definitely more negative for countries with low income and more positive in countries with high income per capita.

Countries with high income inequality in general will benefit more than others from combating income inequality. At the same time, for countries with lower levels of income inequality, the majority of which are developed countries in Continental Europe, toughening fiscal policy for combating income inequality will probably generate negative outcomes for their economies.

The limitation of the study is that we only used the Gini index and market income per household to measure income inequality as well as only using GDP to measure economic growth. In general, we are satisfied with the results of this research, but in future studies it is will be interesting to compare them with calculations of the Gini index based on disposable income and more modern metrics of sustainable economic growth (Kovacic and Giampietro 2015; Hayden and Wilson 2018).

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

Table A1. The results of a vertical analysis of data with the use of a qualitative pairwise correlation comparison method (part 1).

No.	Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	South Africa	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	−2	0
2	Central African Republic	2	0	−2	2	−2	−2	0	0	0	0	2
3	Mexico	0	−2	0	0	−2	0	0	−2	2	0	0
4	Brazil	0	0	0	0	0	2	0	0	0	0	2
5	Chile	−2	0	0	2	0	2	0	2	0		2
6	Sub-Saharan Africa	−2	−2	−2	2	−2	−2	2	2	0	0	0
7	WORLD	0	−2	2	2	0	0	2	2	0	0	−2
8	India	−2	−2	2	−2	2	0	−2	2	0	−2	0
9	Qatar	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10	Turkey	0	−2	2	2	−2		2	−2	0	0	−2
11	USA	2	0	2	2	0	−2	0	2	−2	0	−2
12	Israel	0	−2	0	−2	0	0	2	0	0	2	2
13	Uzbekistan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	−2	0	0
14	China	0	2	0	2	0	0	2	0	0	−2	2
15	Russian Federation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	−2	0
16	Bulgaria	0	0	0	−2	−2	0	0	0	0	0	2
17	Canada	0	−2	2	0	−2	−2	2	0	0	−2	0
18	Korea	2	0	2	0	−2	2	2	0	0	2	2
19	Indonesia	−2	0	2	0	−2	2	−2	2	0	0	
20	Tajikistan	n/a	n/a	n/a	n/a	n/a	0	0	2	0	0	0
21	Japan	0	−2	2	2	2	0	2	2	0	2	−2
22	Australia	2	0	−2	2	2	0	0	2	−2	−2	0
23	Kazakhstan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
24	Germany	−2	−2	2	0	0	0	0	2	2	0	−2
25	Estonia	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
26	Poland	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
27	Azerbaijan	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
28	Ukraine	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	2	0	0
29	Armenia	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
30	Belarus	n/a	0	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	0
31	Great Britain	0	2	2	0	2	0	2	2	−2	0	−2
32	European Union	0	2	0	2	0	2	0	2	0	0	0
33	New Zealand	0	0	2	0	−2	0	−2	0	2	0	−2
34	Spain	−2	2	2	2	2	2	2	0	0	0	−2
35	Italy	−2	0	0	2	0	2	2	2	0	0	−2
36	Finland	−2	2	0	2	2	−2	2	0	−2	−2	−2
37	France	−2	0	0	2	2	2	2	2	0	−2	−2
38	Austria	0	0	0	−2	0	−2	−2	0	0	0	−2
39	Netherlands	0	0	2	2	0	0	−2	2	2	−2	−2
40	Slovenia	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0
41	Norway	−2	−2	0	2	0	−2	−2	−2	0	2	2
42	Sweden	−2	2	2	2	−2	0	0	0	0	−2	0
43	Number of countries with a positive correlation and growth of variables.	4	6	14	17	7	8	13	15	5	4	8

Table A1. *Cont*.

No.	Country	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
44	% of countries with a positive correlation and growth of variables.	13.8%	20.0%	48.3%	58.6%	24.1%	26.7%	43.3%	46.9%	15.6%	12.1%	20.5%
45	Number of countries with a positive correlation and decline of variables.	11	10	3	4	10	7	6	3	5	10	13
46	% of countries with a positive correlation and decline of variables.	37.9%	33.3%	10.3%	13.8%	34.5%	23.3%	20.0%	9.4%	15.6%	30.3%	33.3%
47	Number of countries with a positive correlation (Total).	51.7%	53.3%	58.6%	72.4%	58.6%	50.0%	63.3%	56.3%	31.3%	42.4%	53.8%
48	Number of countries with a negative correlation (Total).	48.3%	46.7%	41.4%	27.6%	41.4%	50.0%	36.7%	43.8%	68.8%	57.6%	46.2%
49	Number of observations (Total). Countries per year.	29	30	29	29	29	30	30	32	32	33	39

Notes: 1. Dates, marked with red color in table footer, correspond with economic and financial crises. 2. We used a method of building heatmaps to highlight the level of indicators in this table. The concept is "blue" = "low level of indicator" and "red" = "high" as well as "red" = "low level of indicator" and "green" = "high".

Table A2. The results of a vertical analysis of data with the use of a qualitative pairwise correlation comparison method (part 2).

No.	Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	South Africa	−2	0	2	0	2	0	0	2	2	0	2
2	Central African Republic	−2	0	0	0	−2	0	−2	−2	−2	0	−2
3	Mexico	−2	−2	2	−2	2	0	0	−2	2	0	0
4	Brazil	0	0	2	−2	−2	0	0	0	2	0	0
5	Chile	0	−2	−2	2	0	0	0	0	2	0	0
6	Sub-Saharan Africa	−2	−2	0	0	0	−2	−2	−2	2	2	2
7	WORLD	2	0	2	0	2	0	0	2	2	−2	0
8	India	2	0	2	2	−2	0	2	2	0	2	0
9	Qatar	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	2
10	Turkey	0	2	0	2	−2	2	−2	−2	2	−2	2
11	USA	2	−2	2	0	2	2	2	2	0	−2	0
12	Israel	2	0	2	0	0	0	0	0	2	0	0
13	Uzbekistan	0	0	−2	0	0	2	0	0	−2	0	−2
14	China	2	0	0	−2	−2	−2	0	0	2	0	2
15	Russian Federation	0	2	0	2	2	0	−2	2	2	0	−2
16	Bulgaria	2	2	2	2	0	−2	0	−2	0	0	2
17	Canada	2	2	2	−2	0	2	0	2	2	−2	2
18	Korea	0	2	2	2	0	0	−2	2	0	0	2
19	Indonesia	−2	0	2	2	0	−2	−2	0	2	0	2
20	Tajikistan	0	0	−2	0	−2	2	2	0	2	2	2
21	Japan	−2	0	2	2	2	−2	0	2	2	0	0
22	Australia	2	2	0	−2	0	2	2	2	0	−2	2
23	Kazakhstan	0	−2	−2	0	0	2	0	2	2	2	−2
24	Germany	−2	−2	0	−2	0	2	2	−2	2	−2	0
25	Estonia	n/a	n/a	−2	2	0	2	0	0	0	−2	2
26	Poland	2	2	2	2	−2	2	0	0	0	0	2
27	Azerbaijan	0	0	2	2	2	2	2	0	2	0	0
28	Ukraine	0	0	0	2	2	2	2	2	2	2	0
29	Armenia	0	2	2	2	0	0	2	0	2	2	2
30	Belarus	0	2	0	2	2	2	0	0	2	0	2
31	Great Britain	0	2	2	0	0	0	0	0	0	0	0

Table A2. *Cont.*

No.	Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
32	European Union	0	0	2	2	0	2	2	0	0	0	−2
33	New Zealand	2	2	−2	−2	−2	0	0	0	−2	2	2
34	Spain	−2	−2	2	0	−2	0	0	2	0	−2	−2
35	Italy	0	0	2	2	0	2	0	−2	2	0	−2
36	Finland	0	2	2	2	−2	2	0	0	2	−2	−2
37	France	0	0	2	−2	0	2	2	−2	2	0	−2
38	Austria	−2	−2	2	2	−2	0	2	−2	0	−2	2
39	Netherlands	−2	0	2	2	0	0	0	2	−2	0	−2
40	Slovenia	2	2	0	0	0	0	0	2	−2	−2	2
41	Norway	2	0	2	0	2	2	−2	0	2	−2	−2
42	Sweden	−2	0	2	2	−2	2	0	0	0	−2	2
43	Number of countries with a positive correlation and growth of variables.	12	13	25	20	10	19	11	14	24	8	19
44	% of countries with a positive correlation and growth of variables.	30.0%	32.5%	61.0%	48.8%	24.4%	46.3%	26.8%	34.1%	58.5%	19.0%	45.2%
45	Number of countries with a positive correlation and decline of variables.	11	8	6	8	12	5	7	9	5	13	11
46	% of countries with a positive correlation and decline of variables.	27.5%	20.0%	14.6%	19.5%	29.3%	12.2%	17.1%	22.0%	12.2%	31.0%	26.2%
47	Number of countries with a positive correlation (Total).	57.5%	52.5%	75.6%	68.3%	53.7%	58.5%	43.9%	56.1%	70.7%	50.0%	71.4%
48	Number of countries with a negative correlation (Total).	42.5%	47.5%	24.4%	31.7%	46.3%	41.5%	56.1%	43.9%	29.3%	50.0%	28.6%
49	Number of observations (Total). Countries per year.	40	40	41	41	41	41	41	41	41	42	42

Notes: 1. Dates, marked with red color in table footer, correspond with economic and financial crises. 2. We used a method of building heatmaps to highlight the level of indicators in this table. The concept is "blue" = "low level of indicator" and "red" = "high" as well as "red" = "low level of indicator" and "green" = "high".

Table A3. The results of a vertical analysis of data with the use of a qualitative pairwise correlation comparison method (part 3).

No.	Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	South Africa	0	0	2	2	0	−2	−2	2	2	0	2
2	Central African Republic	−2	2	0	2	0	0		−2	0	0	0
3	Mexico	0	2	0	2	0	0	−2	0	0	0	−2
4	Brazil	0	2	0	0	0	0	0	0	0	0	0
5	Chile	2	0	−2	2	−2	−2	0	0	2	−2	−2
6	Sub-Saharan Africa	−2	0	0	0	2	−2	−2	2	−2	−2	0
7	WORLD	2	0	−2	0	−2	−2	−2	0	−2	−2	0
8	India	2	2	2	2	0	0	2	2	0	2	2
9	Qatar	−2	0	0	0	0	−2	0	2	0	−2	−2
10	Turkey	−2	0	−2	−2	−2	0	0	0	2	−2	0
11	USA	2	2	0	0	−2	−2	−2	2	0	2	−2
12	Israel	2	2	0	0	0	0	0	2	−2	−2	0
13	Uzbekistan	2	0	0	2	0	0	0	−2	0	0	0
14	China	2	2	2	2	2	0	0	2	−2	−2	0
15	Russian Federation	2	−2	−2	2	0	0	−2	0	0	−2	0
16	Bulgaria	−2	0	0	−2	−2	−2	0	2	0	0	−2
17	Canada	2	2	2	0	2	−2	−2	2	2	−2	2
18	Korea	0	0	−2	2	2	0	−2	2	0	−2	0

Table A3. *Cont.*

No.	Country	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
19	Indonesia	2	2	2	0	2	0	−2	0	−2	−2	−2
20	Tajikistan	2	0	−2	0	0	0	−2	2	2	2	0
21	Japan	2	2	0	0	2	−2	−2	2	−2	2	2
22	Australia	−2	2	0	0	0	−2	0	2	0	2	0
23	Kazakhstan	−2	0	2	0	−2	−2	0	0	0	0	0
24	Germany	−2	2	0	2	0	0	0	0	0	−2	2
25	Estonia	2	−2	2	0	−2	−2	−2	2	2	0	0
26	Poland	2	2	0	2	0	0	−2	0	2	−2	0
27	Azerbaijan	2	0	2	2	0	−2	−2	0	0	2	0
28	Ukraine	2	2	0	2	2	−2	−2	2	2	0	−2
29	Armenia	2	0	2	0	2	−2	−2	2	2	2	−2
30	Belarus	2	2	0	2	0	0	−2	2	0	0	−2
31	Great Britain	2	−2	2	0	0	−2	0	0	0	−2	2
32	European Union	−2	2	0	2	0	−2	−2	0	0	−2	2
33	New Zealand	0	−2	−2	−2	2	−2	2	0	2	0	0
34	Spain	2	0	0	2	0	−2	0	0	−2	−2	2
35	Italy	−2	0	−2	2	0	−2	−2	2	0	0	0
36	Finland	0	2	−2	2	2	0	−2	2	−2	−2	0
37	France	0	2	−2	0	0	0	−2	2	2	−2	0
38	Austria	0	0	0	2	0	0	−2	2	0	−2	−2
39	Netherlands	0	2	2	2	2	−2	0	2	0	0	0
40	Slovenia	0	2	0	2	0	−2	−2	2	−2	0	0
41	Norway	0	2	0	0	0	0	−2	2	2	2	−2
42	Sweden	2	2	0	2	0	−2	−2	2	−2	−2	2
43	Number of countries with a positive correlation and growth of variables.	21	22	11	22	11	0	2	25	12	8	9
44	% of countries with a positive correlation and growth of variables.	50.0%	52.4%	26.2%	52.4%	26.2%	0.0%	4.9%	59.5%	28.6%	19.0%	21.4%
45	Number of countries with a positive correlation and decline of variables.	10	4	10	3	7	23	25	2	10	20	11
46	% of countries with a positive correlation and decline of variables.	23.8%	9.5%	23.8%	7.1%	16.7%	54.8%	61.0%	4.8%	23.8%	47.6%	26.2%
47	Number of countries with a positive correlation (Total).	73.8%	61.9%	50.0%	59.5%	42.9%	54.8%	65.9%	64.3%	52.4%	66.7%	47.6%
48	Number of countries with a negative correlation (Total).	26.2%	38.1%	50.0%	40.5%	57.1%	45.2%	34.1%	35.7%	47.6%	33.3%	52.4%
49	Number of observations (Total). Countries per year.	42	42	42	42	42	42	41	42	42	42	42

Notes: 1. Dates, marked with red color in table footer, correspond with economic and financial crises. 2. We used a method of building heatmaps to highlight the level of indicators in this table. The concept is "blue" = "low level of indicator" and "red" = "high" as well as "red" = "low level of indicator" and "green" = "high".

Table A4. The results of a vertical analysis of data with the use of a qualitative pairwise correlation comparison method (part 4).

No.	Country	2014	2015	2016	2017	2018
1	South Africa	0	0	−2	0	0
2	Central African Republic	0	0	2	−2	−2
3	Mexico	2	0	−2	−2	0
4	Brazil	0	−2	2	2	0
5	Chile	−2	2	−2	−2	0

Table A4. *Cont.*

No.	Country	2014	2015	2016	2017	2018
6	Sub-Saharan Africa	−2	−2	−2	0	−2
7	WORLD	0	0	−2	0	−2
8	India	2	2	0	0	0
9	Qatar	0	−2	0	−2	−2
10	Turkey	−2	0	0	0	−2
11	USA	2	0	−2	0	2
12	Israel	−2	−2	0	−2	0
13	Uzbekistan	−2	0	0	0	0
14	China	−2	0	−2	2	0
15	Russian Federation	−2	−2	2	0	2
16	Bulgaria	2	2	0	0	0
17	Canada	2	−2	0	2	−2
18	Korea	2	0	2	2	−2
19	Indonesia	−2	0	2	2	0
20	Tajikistan	−2	−2	2	2	−2
21	Japan	−2	2	−2	0	0
22	Australia	−2	0	0	0	2
23	Kazakhstan	−2	−2	0	2	0
24	Germany	2	−2	0	0	−2
25	Estonia	0	−2	0	0	0
26	Poland	2	2	−2	0	0
27	Azerbaijan	0	−2	−2	2	2
28	Ukraine	0	−2	0	2	2
29	Armenia	2	−2	−2	2	0
30	Belarus	2	−2	0	2	2
31	Great Britain	0	−2	−2	−2	−2
32	European Union	2	0	−2	0	−2
33	New Zealand	2	0	0	0	2
34	Spain	2	2	0	0	−2
35	Italy	2	2	2	2	−2
36	Finland	2	2	2	2	0
37	France	0	2	−2	2	0
38	Austria	2	0	2	0	−2
39	Netherlands	2	0	2	2	0
40	Slovenia	2	−2	2	0	0
41	Norway	0	−2	0	2	0
42	Sweden	2	2	−2	2	−2
43	Number of countries with a positive correlation and growth of variables.	19	10	11	17	7
44	% of countries with a positive correlation and growth of variables.	45.2%	23.8%	26.2%	40.5%	16.7%
45	Number of countries with a positive correlation and decline of variables.	12	17	15	6	15
46	% of countries with a positive correlation and decline of variables.	28.6%	40.5%	35.7%	14.3%	35.7%
47	Number of countries with a positive correlation (Total).	73.8%	64.3%	61.9%	54.8%	52.4%
48	Number of countries with a negative correlation (Total).	26.2%	35.7%	38.1%	45.2%	47.6%
49	Number of observations (Total). Countries per year.	42	42	42	42	42

Source: Compiled by the author based on (World Inequality Database 2020; World Bank 2021). Notes: 1. Dates, marked with red color in table footer, correspond with economic and financial crises. 2. We used a method of building heatmaps to highlight the level of indicators in this table. The concept is "blue" = "low level of indicator" and "red" = "high" as well as "red" = "low level of indicator" and "green" = "high".

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