

# Assessing Economic Inequality Through the Lorenz Curve in Central and Eastern European Countries

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## Abstract

*This study analyses economic inequality in Central and Eastern Europe (CEE) using tools such as the Lorenz Curve and the Gini coefficient. Originating in 1905, the Lorenz Curve, conceptualized by Max O. Lorenz, serves as an essential tool in illustrating income distribution, complemented by the Gini coefficient for assessing numerical inequality. Examining a decade of data from eleven CEE countries through Eurostat, the study constructs Lorenz curves, providing a visual and quantitative description of variations in income distribution. Percentile analysis reveals nuanced disparities, providing insight into the evolution of inequality. Methodologically, the study addresses the challenges, recognizing the advantages of the Lorenz curve in detailed information on income distribution, but also its disadvantages in data sensitivity. The findings show that the Lorenz curve and the Gini coefficient work synergistically, providing a comprehensive overview of economic inequality in CEE.*

**Key words:** economic inequality, Lorenz Curve, Gini Coefficient, inequality analysis, income distribution

**J.E.L. classification:** D31, D63, F00, H00.

## 1. Introduction

Economic inequality in Central and Eastern Europe (CEE) has become a central topic in contemporary economic discussions. In the context of this study, we aim to analyze in detail the income distribution in this region, using tools such as the Lorenz Curve and the Gini coefficient. These will not only give us a visual perspective on how economic resources are distributed, but also a numerical measure of the degree of inequality.

Originally developed by the American economist Max O. Lorenz in 1905, the Lorenz Curve has become an essential tool in illustrating income distribution and has become a focal point in assessing economic inequality. In combination with the Gini coefficient, it provides a comprehensive view of how a society distributes its resources.

This study aims to make a significant contribution to the specific understanding of economic inequality in the E.E.C. The article examines ten years of data from eleven countries in the region, using information accurately extracted from Eurostat, the European Union's main provider of statistics.

The paper used the data to construct Lorenz Curves, highlighting variations in income distribution within each country and across decades. Through our detailed analysis, the aim is to highlight significant differences in income distribution and provide insight into the evolution of inequality in CEE. This approach not only complements the existing literature on inequality, but also brings to the fore region-specific issues that may influence future economic and social policies.

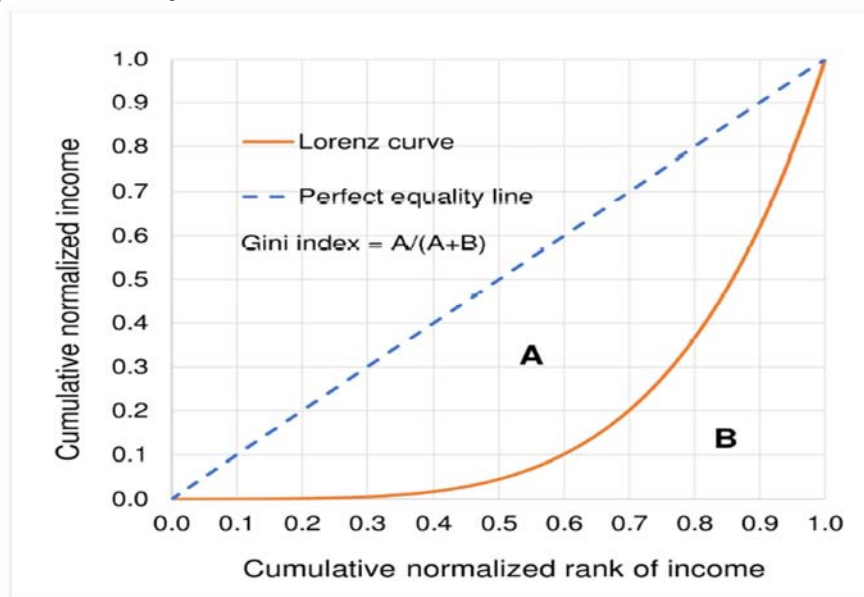
## 2. Literature review

Originally developed by the American economist Max O. Lorenz in 1905, the Lorenz curve is a fundamental method for quantifying the concentration of wealth in a population. According to research by Sitthiyot and Holasut (2023), it is a graphical relationship between the cumulative normalized rank of the population, starting from the poorest to the richest, and the cumulative normalized wealth held by that population in the same sequence.

With a history of more than a century of use, the Lorenz curve has become a widely used tool for highlighting the distribution of income and assessing inequality within that distribution (Sitthiyot and Holasut, 2021). Its significant contribution in measuring and comparing income inequality is also highlighted by Paul and Shankar (2020). In addition, the Lorenz curve serves as the foundation for calculating the Gini index, according to Gini (2005), a common measure of inequality expressed as the ratio of the area between the line of perfect equality and the Lorenz curve (A) to the total area below the line of perfect equality (A + B).

The Gini index, with values between 0 and 1, reflects the degree of inequality in income distribution: the closer it is to 0, the more equal the distribution, while the closer it is to 1, the more unequal it is. It is important to note that, according to research by Sitthiyot and Holasut (2021), the Lorenz curve can be estimated using various methods, including interpolation techniques, assuming specific functional forms for the income distribution, and specifying parametric functional forms for the Lorenz curve.

Figure no. 1. Lorenz Curve



Source: (Sitthiyot T, Holasut K. 2023)

## 3. Research methodology

The data for this study were obtained from Eurostat, the official statistical body of the European Union, known for providing standardized and verified data on economic and social issues in EU member countries. Data for each country and year were entered and managed in a time series analysis. A variable of interest, such as the Gini coefficient, was selected to measure inequality in income distribution in Central and Eastern European (CEE) countries.

Data were collected for the variable of interest for each country in the region over a 10-year period. For each year, countries were ranked according to the variable of interest. Cumulative percentages of the variable were calculated for each country, reflecting the total proportion held by different percentages of the population. The cumulative percentages were used to construct the Lorenz Curve for each country and year.

This involved drawing a line on a graph with the axes representing the percentage of the population and the cumulative proportion of the variable.

Lorenz Curves of different countries were compared to show differences in income distribution. Detailed interpretations were provided, including the identification of the countries with the highest and lowest inequality. The link between the Lorenz Curve and the Gini coefficient was highlighted, showing how these two concepts work together to provide a comprehensive picture of economic inequality.

In order to obtain detailed information on inequality at different levels of the distribution, the corresponding 50th and 90th percentiles for each country were analyzed and highlighted. The methodology included a detailed discussion of the advantages and disadvantages of using the Lorenz Curve in inequality analysis, highlighting the sensitivity to data quality and the challenges of curve construction.

The study concluded on the degree of inequality in income distribution in CEE countries, highlighting the importance of the Lorenz Curve and the Gini coefficient in the analysis of economic inequality. This methodology provided a detailed analysis of income distribution and highlighted variations in inequality between the countries analyzed.

#### **4. Findings**

The Lorenz curve is a concept used in the analysis of economic distribution and income inequality. It is used to visualize and quantify the degree of inequality in the distribution of income or other economic variables among members of a population.

Concentration analysis is based on the Lorenz curve which is usually constructed for distributions built on grouping intervals and involves the following steps:

- the individual values of the variable under study are ordered in ascending order;
- calculate the total proportion of income (or of the variable in question) held by each percentage of the population (e.g. the first 20%, the next 20% and so on);
- construct the Lorenz curve by plotting these proportions, where on the horizontal axis are the percentages of the population and on the vertical axis is the proportion of income held by these percentages of the population.

In a perfectly equal distribution, where each individual has the same proportion of income, the Lorenz curve would coincide with the 45 degree diagonal of the graph. The further the curve moves away from this diagonal, the greater the inequality in income distribution. In other words, when the Lorenz curve gets closer to the upper left corner of the graph, it means that a smaller proportion of the population has a higher proportion of the income, indicating greater inequality.

The Lorenz curve is often used in combination with the Gini coefficient, which is a numerical indicator of inequality, to quantify and compare economic inequality between different countries or regions.

Table no. 1 Table of percentage distribution of population in central and Eastern European Countries

Cum. Pop.(%)	Bulgaria	Czechia	Croatia	Estonia	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia	Hungary
0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
10%	1.87%	4.07%	2.96%	3.00%	2.48%	2.34%	2.15%	1.64%	3.54%	4%	4%
20%	5.68%	10.01%	8.02%	8.08%	7.00%	6.70%	7.06%	5.49%	9.55%	10%	9%
30%	10.71%	16.84%	14.30%	14.12%	12.61%	12.25%	13.21%	10.82%	16.74%	17%	16%
40%	16.70%	24.40%	21.65%	20.91%	19.15%	18.73%	20.48%	17.53%	24.91%	24%	23%
50%	23.75%	32.83%	30.16%	28.74%	26.74%	26.21%	28.80%	25.68%	34.02%	33%	32%
60%	31.92%	42.07%	39.75%	37.79%	35.54%	34.98%	38.15%	35.30%	43.99%	42%	41%
70%	41.52%	52.33%	50.57%	48.38%	45.71%	45.24%	48.69%	46.38%	54.94%	53%	52%
80%	53.33%	64.09%	63.01%	61.02%	57.90%	57.39%	60.78%	59.49%	67.07%	65%	64%
90%	68.58%	78.40%	77.75%	76.66%	73.26%	72.78%	75.37%	75.35%	81.17%	79%	78%
100%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100%	100%

Source: Authors's contribution

The data in Table no. 1 represent the cumulative population percentage distribution for each country in the group analyzed. Each column represents a specific country and each row indicates the percentage range of the cumulated population. Below are some comments on the data analyzed:

- the first column, "Cumulative Population %", shows the proportion of the cumulative population in each range. For example, at 10%, the cumulative population is 1.87% for Bulgaria, 4.07% for the Czech Republic, and so on;

- the values in the table show the cumulative population percentage for each interval. For example, at 20%, the cumulative population is 5.68% for Bulgaria, 10.01% for the Czech Republic, and so on;

- the table provides an insight into the distribution of the population by percentage range. It can be used to assess the relative distribution of the population within the group of countries;

- this data can be useful to compare the relative proportion of the population in different categories and to understand how the population is distributed in the group of countries.

In Table no. 1 is shown the cumulative population percentages and associated values for each country and percentage range. The percentages and values in the table were appropriate for constructing the Lorenz curve. This data is to plot the curve and to analyze distribution and inequality within the population.

In our case, data was collected for 11 countries over a period of 10 years. To construct the Lorenz curve for this data, it was needed:

- rank countries by the variable of interest (such as Gini coefficient, tax burden or GDP) for each year;

- calculate the cumulative proportion of the variable of interest to the total for each country and year. This can be expressed as the total percentage of the variable up to a certain point;

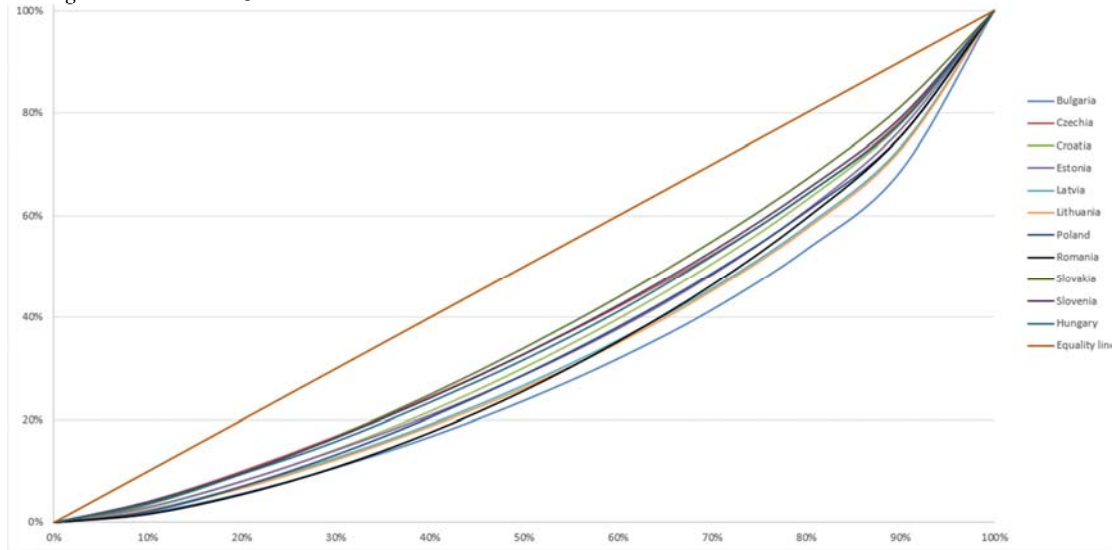
- constructing a curve by connecting the points representing the cumulative proportion of the variable for each country and year in ascending order of the variable;

- drawing a diagonal line from the origin (0%, 0%) to the point on the Lorenz curve corresponding to 100%;

- comparing the Lorenz curve obtained with the diagonal line. The more the curve deviates from the diagonal line, the greater the inequality in the distribution of the variable.

This analysis can give us an insight into the relative distribution of the variable of interest within the 11 countries over the 10 years.

Figure no. 2. Lorenz Curve in



Source: Authors's contribution

In Figure no. 2 it can be seen that as the percentage of population increases, the variable of interest accumulates in a higher proportion for some countries. This may indicate greater inequality in the distribution of the variable of interest between the countries under analysis. The Lorenz curve provides a visual insight into the relative distribution of the variable of interest and can help in the analysis of inequality within the population. To determine which country is most affected in terms of inequality or distribution, we can follow the Lorenz curve. The further the curve is from the line of equality (the diagonal line from 0% to 100%), the greater the inequality. There are several ways to interpret this:

- the point on the Lorenz curve furthest from the equality line indicates the maximum degree of inequality in the population distribution. So the country with a higher percentage on this point will have higher inequality;
- the area between the Lorenz curve and the equality line is the measure of inequality in the population. The larger this area, the more pronounced the inequality. Thus, a comparison of the areas between the Lorenz curves of different countries and identify the country with the largest area, indicating greater inequality;
- comparing the slope of the Lorenz curves can also give clues about inequality. A steeper curve indicates greater inequality, while a smoother curve indicates a more equal distribution.

By analyzing these issues and comparing Lorenz curves for each country, an insight can be gained into the degree of inequality or distribution of resources and income in each country.

The advantage of the Lorenz curve would be that it provides detailed information on the distribution of income in a population and allows a more accurate view than some summary statistics. By showing the distribution at each percentile, the Lorenz curve provides a clear picture of how incomes differ from the equality line. The data needed to construct the Lorenz curve are also essential for calculating the Gini coefficient, which is an important measure of inequality.

When sufficient data are available, the Lorenz curve can be generated for different geographical regions, providing tax policy makers with a more detailed insight into the optimal use of tax brackets and systems.

The disadvantage is the construction of the curve. Specifically, it involves fitting a continuous function to an incomplete data set, which does not ensure that the values on the Lorenz curve reflect the true income distribution. This is due to the difficulty or cost of collecting all the necessary data. Most of the points on the Lorenz curve are extrapolations based on the shape of the curve that best fits the observed data. As a result, the shape of the Lorenz curve can be sensitive to the quality and size of the data sample as well as mathematical assumptions, which can lead to errors between the Lorenz curve and the true distribution.

The Lorenz curve describes the income distribution for the year 2021. The dataset is also compared to a straight diagonal line representing perfect equality (assuming a perfect society, the bottom half of the population would receive 50% of the total). For the countries analyzed, at the 50th percentile of income, the corresponding Lorenz curve values are shown in Table no. 2 (The corresponding percentage means that the top half of the population receives that percentage of the national total income).

*Table no. 2 Percentile distribution at 50% in Central and Eastern European Countries*

Prcnt.	Bulgaria	Czechia	Croatia	Estonia	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia	Hungary
50%	23.75%	32.83%	30.16%	28.74%	26.74%	26.21%	28.80%	25.68%	34.02%	32.83%	31.74%

*Source:* Authors's contribution

It can be seen that most countries are below the 30% threshold (Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania), however there are also a few countries that are above this level (Czech Republic, Croatia, Slovakia, Slovenia and Hungary). In terms of inequality at the 50th percentile level, Bulgaria (23.75%) and Romania (25.68%) stand out as having the highest inequality, while Slovakia (34.02%) has the lowest level of inequality. If inequality is examined from the perspective of the 90th percentile, the corresponding Lorenz curve values are as follows:

*Table no. 3 Percentile distribution at 90% in Central and Eastern European Countries*

Prcnt.	Bulgaria	Czechia	Croatia	Estonia	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia	Hungary
90%	68.58%	78.40%	77.75%	76.66%	73.26%	72.78%	75.37%	75.35%	81.17%	79.02%	77.98%

*Source:* Authors's contribution

In this situation, Bulgaria retains the position of the country with the highest inequality (68.58%), while Slovakia remains the country with the lowest level of inequality (81.17%). The Lorenz curve and the Gini coefficient are two closely related concepts in the analysis of economic inequality. Both are used to measure the unequal distribution of a variable, such as income, wealth or consumption, in a population.

The Lorenz curve is a graphical representation of the cumulative distribution of a variable as a percentage of the population. It compares the true distribution with a perfect equal distribution, represented by a diagonal line. The more the Lorenz curve deviates from the diagonal line, the greater the inequality.

The Gini coefficient is a numerical indicator used to measure the inequality of a variable. It is calculated from the Lorenz curve and gives a value between 0 and 1, where 0 indicates a perfectly equal distribution and 1 indicates a perfectly unequal distribution. The closer the Gini coefficient is to 1, the greater the inequality.

The Lorenz curve and the Gini coefficient are therefore complementary tools in the analysis of economic inequality and are often used together to get a more comprehensive picture of the distribution of variables in a population.

## 5. Conclusions

This study provided a detailed look at income distribution in Central and Eastern Europe, using the Lorenz Curve and the Gini coefficient as key analytical tools. A first conclusion would be the significant variations in income distribution. The Lorenz Curve analysis revealed significant differences in income distribution between CEE countries. From Bulgaria to Slovenia, each country showed distinct patterns of inequality, reflecting the economic diversity of the region.

The corresponding 50th and 90th percentile values provided deep insights into inequality in different strata of the population. From countries with high inequality to those with more equitable distributions, this detailed percentile analysis brought to light the variability in income distribution.

Analyzing data over a 10-year period, there can be observed significant changes in economic inequality in the CEE. Some countries have seen significant improvements, while others have experienced increases in inequality, highlighting the complex dynamics of economic and social factors in the region.

The Lorenz curve has been an essential tool in providing a detailed visual representation of income distribution. Approaching a perfect equal distribution, this curve revealed subtleties and trends that could not have been captured by summary measurements.

The calculation of the Gini coefficient provided a numerical measure of inequality, reinforcing the results obtained by the Lorenz Curve analysis. This dual approach allowed for a comprehensive and robust understanding of income distribution in CEE.

## 6. References

- Gini, C., 2005. On the measurement of concentration and variability of characters (*English translation from Italian by de Santis F.*). *Metron*. 2005; 63: 3–38
- Lorenz, M.O., 1905. Methods of measuring the concentration of wealth. *Pub Am Stat Assoc*. 9: 209–219
- Paul, S., Shankar, S., 2020. An alternative single parameter functional form for Lorenz curve. *Empir Econ*. 59:1393–1402. <https://doi.org/10.1007/s00181-019-01715-3>
- Sitthiyot, T., Holasut, K., 2021. A simple method for estimating the Lorenz curve. *Humanit Soc Sci Commun*. 1–9. <https://doi.org/10.1057/s41599-021-00948-x>
- Sitthiyot, T., Holasut, K., 2023. An investigation of the performance of parametric functional forms for the Lorenz curve. *PLoS ONE*. 18(6): e0287546. <https://doi.org/10.1371/journal.pone.0287546>
- \* \* \* Eurostat., 2021. Available at: <https://ec.europa.eu/eurostat/databrowser/view/tessi190/default/table?lang=en>
- \* \* \* Eurostat., 2021. Available at: [https://ec.europa.eu/eurostat/databrowser/view/sdg\\_10\\_41/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/sdg_10_41/default/table?lang=en)
- <https://www4.wider.unu.edu/?ind=1&type=ChoroplethSeq&year=70&byCountry=false&slider=button>