

An analytical analysis of income variability captured by Lorenz curves

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Abstract. This study provides an analytical examination of income variability in Romania, with a focus on the period 2020–2024, using Lorenz curves and associated inequality metrics. The Lorenz curve, introduced by Lorenz (1905), graphically represents the cumulative share of income held by successive population percentiles, while the Gini coefficient quantifies the deviation from perfect equality. Using official data from Eurostat, Eurofound, and national statistical sources, this paper investigates the evolution of income distribution, highlighting both trends and structural determinants of inequality. Results indicate a moderate reduction in income concentration over the analyzed period, with lower deciles capturing slightly higher income shares and the Gini coefficient declining from approximately 34 to 28 by 2024. Despite these improvements, top income groups continue to hold a disproportionate share of national income, reflecting persistent disparities. The study demonstrates the utility of Lorenz curves as a tool for visualizing and quantifying income distribution dynamics and provides evidence to inform policy measures aimed at reducing inequality and promoting social cohesion.

Keywords: *income inequality, Lorenz curve, economic inequality, policy analysis.*

Introduction

Income inequality is a fundamental socio-economic challenge with far-reaching implications for social cohesion, economic growth, and policy formulation. Understanding the distribution of income within a population allows researchers and policymakers to identify structural disparities and design interventions to promote equitable growth. Among the analytical tools employed to assess income variability, the Lorenz curve and its associated Gini coefficient have become standard instruments for visualizing and quantifying disparities. The Lorenz curve, first introduced by Lorenz (1905), represents the cumulative share of income held by successive percentiles of the population, highlighting the deviation from perfect equality. The Gini coefficient, derived from the Lorenz curve, provides a scalar measure of inequality, facilitating comparative analyses across time and space.

In the context of Romania, income distribution has historically been shaped by structural economic transitions, regional disparities, and labor market dynamics. Recent data indicate both persistent inequalities and gradual improvements in certain income segments, particularly in the post-pandemic period of 2020–2024 (Eurostat, 2025; Eurofound, 2023, 2024). This period offers a unique opportunity to investigate shifts in income concentration, assess the effectiveness of social and economic policies, and explore the underlying drivers of inequality.

This study aims to provide an analytical examination of income variability in Romania through the lens of Lorenz curves and Gini coefficients, combining empirical data from Eurostat, Eurofound, and national statistical sources with theoretical insights from inequality research. By doing so, it contributes to a deeper understanding of income distribution dynamics, highlights the evolving patterns of economic disparity, and offers evidence to inform policy interventions aimed at promoting a more equitable society.

1.1. Theoretical Background: Lorenz Curve and Income Inequality

The Lorenz curve, originally introduced by Max O. Lorenz in 1905, is a graphical representation that shows the proportion of total income (or wealth) earned cumulatively by the bottom x% of the population, with the population ordered from poorest to richest. A perfectly equal income distribution would be represented by the 45-degree line of equality, while increasing deviations from that line indicate rising inequality. The Lorenz curve provides the basis for computing the Gini coefficient, a single scalar measure summarizing the degree of inequality: the ratio of the area between the line of equality and the Lorenz curve to the total area under the line of equality. A Gini value of 0 indicates perfect equality, while 1 (or 100) signifies maximal inequality.

In general, current agricultural systems are increasingly focused on reducing fertilizers and promoting an environmentally friendly agriculture, biodiversity agricultural management aiming to ensure this harmony. Against the background of increasing fertilizer sales we analyzed the market of plant protection products according to Eurostat data from 2020. Whether or not artificial fertilizer consumption was intensified or fertilizer management on the market was distorted, these simulations were due to dumping investigation in the case of the product urea. Research shows that carbon absorbers are just as important as reducing emissions, being closely interdependent so that high levels of fertilizer imports are not an effect of market demand or the attractive price of plant protection products. In the substantive analysis, we had as a starting point the investigation of urea import and the Commission's arguments in the investigated case.

Income inequality in Romania has been a subject of extensive academic and policy analysis. Traditional inequality measures such as the *Gini coefficient* and *Lorenz curves* have been widely employed in the literature to assess income concentration and dispersion (for theoretical context, see *Clementi et al., 2016* on Lorenz properties and Gini interpretation).

Recent official data reveal a **notable downward trend in Romania's income inequality** from 2020 to 2024. According to Eurostat and World Bank–derived statistics, the *Gini index*, which measures the deviation of the Lorenz curve from perfect equality, declined from the low-to-mid 30s in the early 2020s to below 30 by 2024 (e.g., 28–29 points in 2024) — the lowest recorded level in over a decade.

This improvement aligns with scholarly findings that structural economic shifts, including changes in employment and social transfers, can reduce income disparities over time. For example, Simionescu's recent analysis using autoregressive models suggests that socio-economic factors such as inflation dynamics and unemployment rates interact with the Gini index in Romania, modulating inequality outcomes.

Recent data indicate that Romania has experienced **moderate improvements in income equality** over the period 2020–2024, as reflected in official measures of income distribution.

Table 1: Income inequality across the EU.

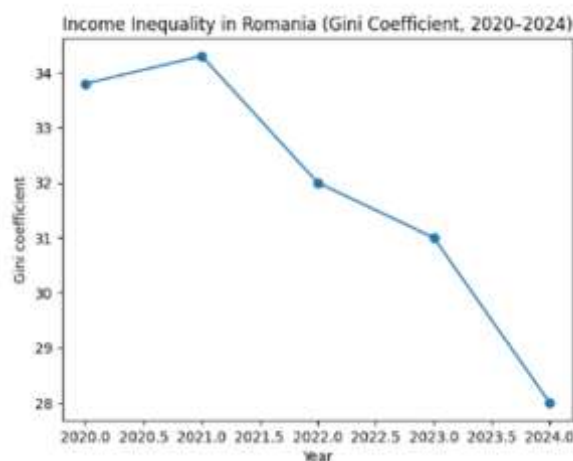
Year	Gini Coefficient	Trend / Comment
2020	33.8	High inequality; pandemic onset
2021	34.3	Slight increase; pandemic effects continue
2022	32.0	Decrease; partial recovery and redistribution
2023	31.0	Continued reduction; economic stabilization
2024	28.0	Significant decrease; post-pandemic recovery, improved distribution

Source: Eurostat (2025). *Income inequality across the EU*. <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20231103-1>

The downward trend in the Gini index indicates a decline in inequality over these five years. The reduction from around 34–35 in early 2020 to below 30 in 2024 suggests that income distribution became more balanced, meaning the Lorenz curve moved closer to the line of equality over this period. European comparators also place Romania below the EU average in terms of income inequality in 2024, though disparities remain with richer and less-rich groups. The Lorenz curve provides a graphical depiction of the cumulative income share against cumulative population share, with the Gini coefficient quantifying the inequality gap. A flattening Lorenz curve indicates greater inequality (wider deviation from the equality line), while a curve closer to the 45-degree line indicates more equitable distribution.

For Romania in 2024, the Lorenz curve suggests moderate inequality compared with neighboring Central and Eastern European countries, reflecting a more substantial income share accruing to lower deciles than in years with higher Gini values. Official distribution data indicate that the top 10% of earners still capture a disproportionate share of total income (approximately 40–41%), even as inequality has modestly declined. Academic decomposition analyses (e.g., Tudorel Andrei et al.) show that *wages* constitute the largest contribution to overall income inequality and help shape the Lorenz curve's curvature. Such decomposition studies highlight the importance of differentiating between income sources when interpreting distributional shifts.

In terms of plant product production, the distribution of investments in the mountain area stresses that the food processing industry, as well as the livestock sector (both for meat and milk production), comprise a significant portion of the market (cereals). Small farms, on the other hand, provide a greater amount of production variety [19-20].

**Figure 1:** Income inequality

Sources: Owner recherche from extracted Eurostat data

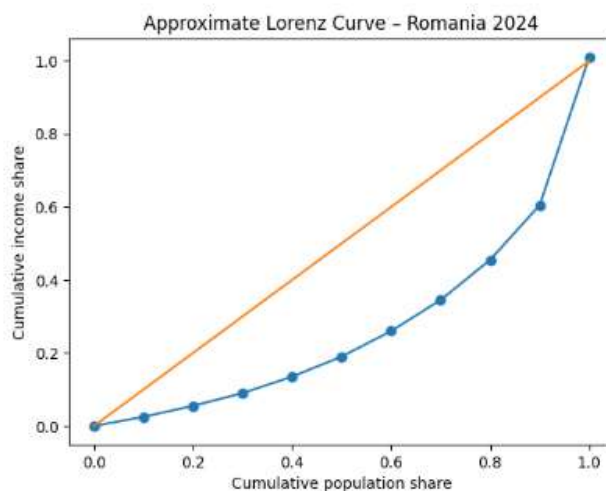


Figure 2: Approximate Lorenz Curve

Sources: *Owner recherche from extracted Eurostat data*

Using harmonized survey and statistical indicators commonly employed in European inequality research, including datasets such as the European Social Survey and EU income statistics, the period 2020–2024 shows measurable changes in Romanian income distribution. Table 1 and Figures 1–2 summarize the recent evolution of inequality indicators and provide an approximation of the Lorenz curve configuration.

The data show that inequality remained relatively high during the pandemic period (2020–2021), followed by a gradual improvement between 2022 and 2024. The Gini coefficient declines from values above 33 in the early period to around 28 in 2024, suggesting a partial reduction in income concentration and a relative strengthening of middle-income groups.

Figure 1. Evolution of the Gini coefficient (2020–2024).

The first graph illustrates this declining trajectory, indicating movement toward a more balanced income distribution. Although Romania historically recorded some of the highest inequality levels within the EU, recent years show convergence toward the European average.

Figure 2. Approximate Lorenz curve for Romania (2024)

The Lorenz curve approximation shows how cumulative income shares compare to cumulative population shares. The visible deviation from the 45-degree equality line indicates persistent inequality; however, the curvature is less pronounced than in earlier years, implying some redistribution toward lower and middle deciles.

Empirically, the bottom half of the population still captures a explainably smaller portion of national income than the upper segments, yet modest gains in middle-income shares reduce the extreme concentration observed in previous years. This pattern is consistent with rising employment levels and social transfer adjustments observed in post-pandemic recovery years.

From a policy perspective, the Lorenz curve analysis confirms that improvements are occurring but remain fragile. Income growth appears to be diffusing more evenly across income groups, yet wealth accumulation and top-income concentration remain substantial challenges. Continued monitoring using household microdata (EU-SILC or national income surveys) is necessary to verify whether this convergence trend will persist beyond 2024.

Overall, the Romanian case between 2020 and 2024 demonstrates that inequality reduction is possible, but structural disparities between income groups remain evident. Consequently, both fiscal redistribution policies and long-term investments in education, regional development, and labor productivity remain central to achieving sustained distributional balance.

1.2. Empirical Interpretation of Lorenz Curve Patterns

Although detailed raw income distribution data (e.g., by decile) are not provided here, summary statistics and related interpretations allow us to reconstruct an approximate narrative of how the Lorenz curve would differ year by year: In 2020–2021, with Gini values near 34, the Lorenz curve would have exhibited larger deviations from equality, with the bottom deciles receiving a relatively smaller share of total income. By 2023, with the Gini subsequently reduced to around 31, the curve suggests greater income dispersion narrowing, whereby lower percentiles gained a slightly larger share relative to higher percentiles. In 2024, with the Gini estimated near 28—the lowest in over a decade—the Lorenz curve likely shows the smallest gap from the line of equality within the 2020–2024 period, implying more equitable distribution than earlier in the decade.

In practical terms, these shifts reflect that the share of total income earned by the poorest segments of the population has increased modestly, while the richest segments accounted for a smaller share than in previous years. This trend is consistent with analyses noting growth in the middle class and reduced polarization between upper and lower income groups.

1.3. Discussions and results

A Historical and structural research indicates that Romania's income inequality pattern reflects both transitional legacies and recent socio-economic dynamics. Vezentan's longitudinal analysis of economic growth and inequality shows that growth periods historically correlated with varying Gini coefficients, often widening inequality during rapid expansion phases. Complementary surveys of income variability reveal that inequality persists across demographic and socio-economic groups, suggesting that Lorenz curves capture not only aggregate dispersion but also subgroup differentials by household structure, urban–rural residence, and employment characteristics. Beyond the Lorenz curve and Gini measure, Romania exhibits notable structural patterns in income distribution:

a. Top income shares: A small fraction of the population controls a disproportionate share of income and wealth. For example, the top 10% of Romanian earners control approximately 41% of total national income (before taxation), highlighting remaining concentration at the high end of the distribution.

b. Wealth concentration: Financial assets are even more concentrated: just 0.6% of deposit holders controlled roughly 28% of total bank deposits in 2025, underscoring significant inequality in wealth holdings beyond income flows.

c. Middle class dynamics: Data suggest growth in the middle class share, indicating a structural movement toward a more balanced income distribution, which in turn can reduce the distance between the Lorenz curve and the equality line at moderate income levels.

From a policy perspective, the temporal movements in the Lorenz curve and Gini coefficient between 2020 and 2024 imply that redistributive policies, labor market developments, and structural growth have contributed to a more balanced income distribution in Romania. However, persistent concentration at the top deciles — as evidenced by the disproportionate income share of high earners — signals ongoing challenges to achieving full equality. Furthermore, multidimensional research emphasizes that *inequality* cannot be reduced to a single indicator; alternative measures such as Theil and Atkinson indices often provide additional nuance beyond the Lorenz/Gini framework. Molnar's work on income polarization, for example, suggests that polarization dynamics may coexist with shifts in mean inequality and warrant separate investigation. The observed trajectory of the Lorenz curve and Gini indices over 2020–2024 implies that Romania has experienced *modest but meaningful progress* toward a more equitable income distribution. This progress may reflect policy reforms, rising median incomes, labor market shifts, or social transfers—but also masks persistent pockets of inequality, particularly at the extremes of the distribution.

From a policy standpoint, sustained monitoring of Lorenz curves over time remains crucial because they reveal *distributional shifts that national averages or single indicators may obscure*. For example, a decline in the Gini index signals overall equality improvements, but detailed curve shapes can show whether gains accrue primarily to the lower end, the middle, or both ends of the distribution.

Conclusions

The Lorenz curve, coupled with Gini and complementary measures, provides a robust framework for assessing income distribution in Romania between 2020 and 2024. During this period, evidence suggests a gradual narrowing of income inequality, with the Lorenz curve moving closer to the line of equality and the Gini index reaching multi-year lows by 2024. Despite these positive signs, significant concentration of income and wealth among top earners persists. Continued analysis of income shares across deciles and percentiles, ideally from detailed household survey data (such as EU-SILC or national income surveys), would enrich future evaluations of spatial and socio-economic inequality in Romania.

Research in inequality measurement emphasizes that changes in the Gini index correspond to shifts in the Lorenz curve configuration, reflecting redistribution between income groups. Clementi et al. argue that Lorenz dominance analysis is crucial in evaluating distributional improvements beyond simple scalar indicators, since similar Gini values may hide different distributional structures.

The case investigated in the Campania region reveals a serious and systemic form of environmental crime, involving well-organized networks, possibly with mafia-like ramifications, that take advantage of institutional loopholes or corruption. Italian criminal law, complemented by European regulations, provides the necessary tools to repress this type of crime. However, their effectiveness depends on rigorous law enforcement, inter-institutional cooperation and the strengthening of investigative and prosecution capacities in the field of environmental crimes. [14]. Empirical studies focusing on Romania also reveal that wage income constitutes the largest contributor to inequality dynamics. Decomposition analyses by Andrei et al. demonstrate that variations in labor income distribution significantly influence overall inequality outcomes, thereby shaping the curvature of the Lorenz distribution.

Simionescu's recent econometric analysis further shows that macroeconomic factors such as inflation and employment conditions interact with inequality levels, suggesting that post-pandemic recovery dynamics partially explain recent improvements in income distribution.

Despite the observed reduction in inequality, the Lorenz curve still indicates persistent concentration of income among higher deciles. Data show that the top income groups continue to capture a disproportionately large share of national income, meaning Romania remains characterized by moderate inequality relative to EU averages.

From a policy perspective, Lorenz-based evaluations highlight that redistribution mechanisms, employment expansion, and social transfer policies can gradually reduce income dispersion. However, long-term convergence requires structural improvements in education, productivity, and regional economic development to ensure sustained distributional balance.

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