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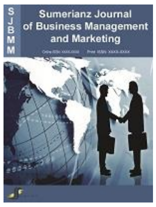

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Rethinking Income Inequality: A Search for the Optimal Distribution

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Abstract

The United Nations' ambitious 2030 Agenda, adopted in September 2015, outlines 17 Sustainable Development Goals (SDGs) with the overarching aim of eradicating poverty and hunger. This agenda represents an unprecedented opportunity to address global challenges. However, one crucial aspect, achieving an appropriate level of income disparity (income inequality), remains a significant hurdle for both academics and policymakers. This research gap necessitates a deeper exploration of the theoretical underpinnings of an optimal income distribution for a given population size. This study delves into this under-researched area by analysing the World Bank's data on population size and the Gini coefficient (a metric for income inequality) for 103 countries (most recent year data available, up to 2023). The analysis employs regression techniques to unveil the relationship between the Gini coefficient and the natural logarithm of population size. The findings suggest a non-linear association, best characterized by a second-degree polynomial function. This implies that the relationship between population size and optimal income distribution is not a simple linear one. Furthermore, the estimated results indicate that the majority of countries in the sample exhibit Gini coefficients that deviate significantly from their theoretically optimal levels. This finding presents valuable insights for policymakers as they design and implement public policies aimed at achieving a more equitable income distribution. The subsequent section delves into a detailed case study of India, analysing its Gini coefficient and the extent of its deviation from the estimated optimal level.

Keywords: Income Inequality; Gini Coefficient; Population Size.

1. Introduction

Income inequality is a pressing issue with significant social and economic consequences. The Gini index, developed by Italian statistician Ceriani and Verme (2024), stands as a crucial tool for measuring the distribution of income within a nation or region. This statistical measure provides a succinct representation of the degree to which income deviates from perfect equality.

The Gini index operates on a scale from 0 to 1, with 0 signifying perfect equality (every resident holds the same income) and 1 representing perfect inequality (one individual earns all the income, while everyone else earns nothing). A higher Gini coefficient indicates a greater concentration of income amongst a select portion of the population, while a lower coefficient reflects a more equitable distribution.

The Gini index offers valuable insights beyond its core function. It can be adapted to analyse wealth distribution, though wealth is notoriously more challenging to measure accurately compared to income. Consequently, Gini coefficients typically reference income and are often simply referred to as the Gini coefficient or Gini index, with the implicit understanding that they pertain to income distribution. Interestingly, wealth Gini coefficients often exhibit significantly higher values than income Gini coefficients, highlighting the tendency for wealth to accumulate in the hands of a smaller number of individuals even in societies with relatively equal income distribution.

While the Gini index is an invaluable instrument for analysing income or wealth distribution within a specific geographical area, it is essential to avoid interpreting it as an absolute measure of income or wealth. Two countries, one high-income and one low-income, could potentially have identical Gini coefficients as long as income distribution within each nation demonstrates similar patterns. For instance, data from the Organisation for Economic

Co-operation and Development (OECD) indicates that Turkey and the United States possess nearly identical Gini coefficients, despite Turkey's considerably lower gross domestic product (GDP) per capita. This observation underscores the fact that the Gini index primarily focuses on the relative distribution of income within a population, not the absolute level of income itself.

The Gini index is often represented graphically through the Lorenz curve, as depicted below in Figure-1, which shows income (or wealth) distribution by plotting the population percentile by income on the horizontal axis and cumulative income on the vertical axis. The Gini coefficient is equal to the area below the line of perfect equality (0.5 by definition) minus the area below the Lorenz curve, divided by the area below the line of perfect equality. In other words, it is double the area between the Lorenz curve and the line of perfect equality. The line at 45 degrees thus represents perfect equality of incomes. The Gini coefficient can then be thought of as the ratio of the area that lies between the line of equality and the Lorenz curve (marked A in the diagram) over the total area under the line of equality (marked A and B in the diagram); i.e., G = A/(A + B). If there are no negative incomes, it is also equal to 2A and 1 − 2B due to the fact that A + B = 0.5. The Gini coefficient is equal to the area marked A divided by the total area of A and B i.e. Gini = A/A+B. The axes run from 0 to 1, so A and B form a triangle of area 1/2 and Gini = 2A = 1-2B.

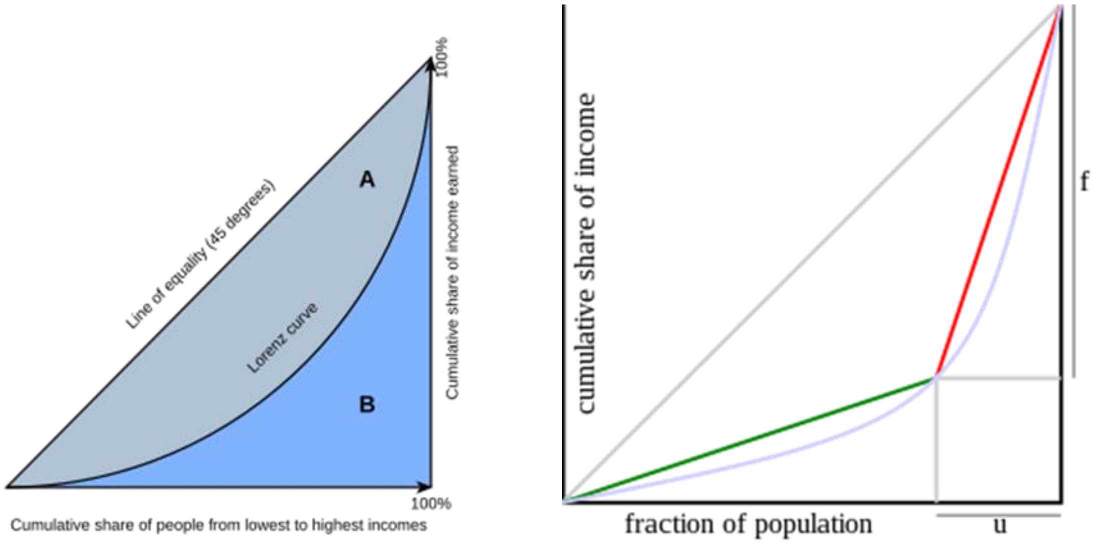

Figure-1.

Richest u of population (red) equally share f of all income or wealth; others (green) equally share remainder: G = f − u. A smooth distribution (blue) with the same u and f always has G > f − u.

Some of the world’s poorest countries have some of the world’s highest Gini coefficients, while many of the lowest Gini coefficients are found in wealthier European countries. However, the relationship between income inequality and GDP per capita is not one of perfect negative correlation, and the relationship has varied over time.

2. Limitations of the Gini Index

Though useful for analysing economic inequality, the Gini coefficient has some shortcomings. The metric’s accuracy is dependent on reliable GDP and income data. Shadow economies and informal economic activity are present in every country. Informal economic activity tends to represent a larger portion of true economic production in developing countries and at the lower end of the income distribution within countries. In both cases, this means that the Gini index of measured incomes will overstate true income inequality. Accurate wealth data is even more difficult to come by due to the popularity of tax havens that obscure the amounts of money held by the wealthiest.

Another flaw is that very different income distributions can result in identical Gini coefficients. Because the Gini attempts to distil a two-dimensional area (the gap between the Lorenz curve and the equality line) down to a single number, it obscures information about the shape of inequality. Though using the Lorenz curve as a supplement can provide more information in this respect, it also does not show demographic variations among subgroups within the distribution, such as the distribution of incomes across age, race, or social groups. In that vein, understanding demographics can be important for understanding what a given Gini coefficient represents. For example, a large retired population pushes the Gini higher. The Gini coefficients of some of the countries overtimes are shown in the following figure-2.

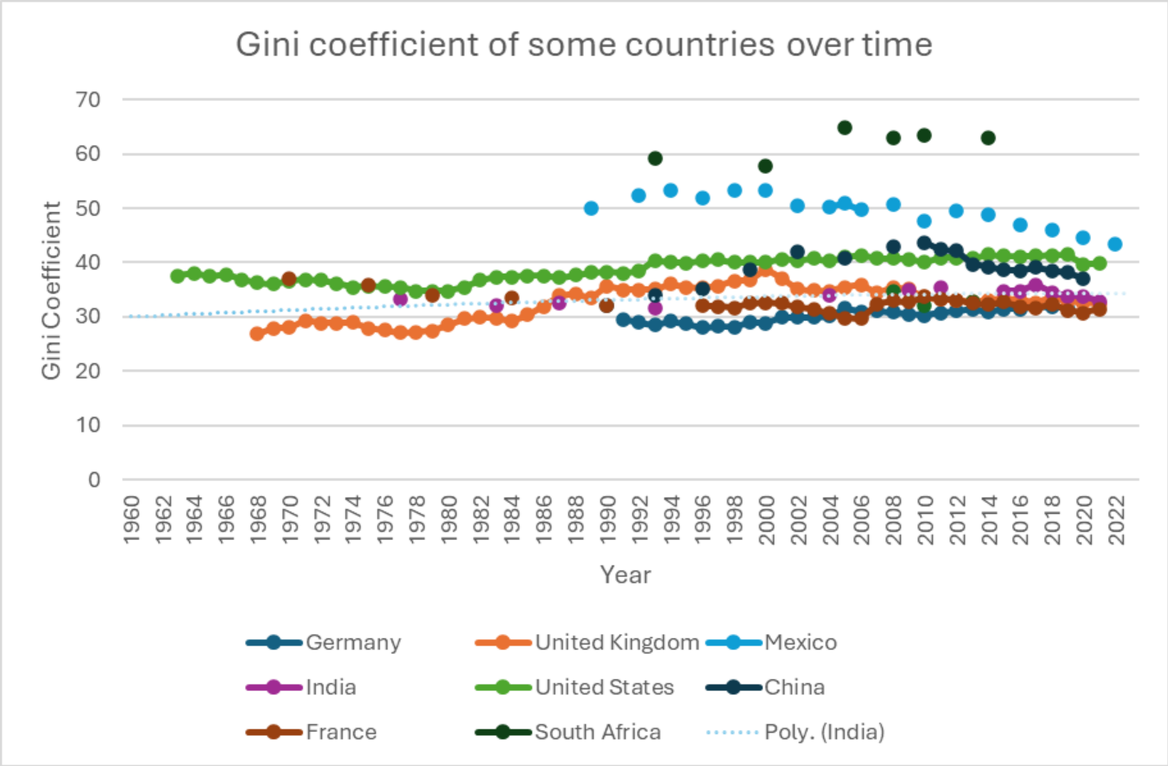

Figure-2.

Given that there are various economic, social, and political factors that could have effects on income inequality as investigated by earlier research,4 it is interesting to examine the linkage between the degree of income inequality as measured by Gini coefficient and the population size, and find out empirically an appropriate value of Gini coefficient given the size of population since no study has been conducted thus far. With an exception of two extreme cases of perfect income equality and perfect income inequality regardless of population size, this study hypothesizes that a country with small populations should have relatively lower Gini coefficient than a country with large populations due to the degree of economic, social, and political diversities as already reflected by the size of population.

2.1. Why Search for Optimal Distribution

Rampant income inequality, characterized by a vast concentration of wealth at the top of the income distribution, poses a multifaceted threat to societal well-being. As evidenced by Fuentes-Nieva and Galasso (2014), such excessive disparities can exert a deleterious effect on economic growth and poverty reduction efforts. Furthermore, the accumulation of inordinate wealth can have a corrosive influence on the principles of equal political representation. When wealth becomes a dominant factor in public policymaking, legislation and regulations are at risk of being warped to serve the interests of the affluent, often to the detriment of the rest of society. Equally concerning is the potential for the wealthy to manipulate public discourse through ownership or control of media outlets. As Raza (2016) suggests, this can lead to large-scale propaganda campaigns that skew public opinion and potentially sway election outcomes. These factors, if left unchecked, can contribute to the erosion of democratic governance, the fragmentation of social cohesion, and the vanishing of equal opportunities for all. The adverse consequences of unmitigated income inequality extend beyond the present generation. Fuentes-Nieva and Galasso (2014) posit that it can create a self-perpetuating cycle of advantage, where the children of the wealthy inherit the best education, healthcare, and access to the lowest tax rates. This entrenches existing inequalities and makes social mobility an even more arduous undertaking for future generations.

While the detrimental effects of rampant income disparity are widely acknowledged, the potential drawbacks of absolute income equality warrant further exploration. Research by Thammasat Review of Economic and Social Policy (2016), posits that an egalitarian distribution of income, irrespective of the political system, could engender a multitude of economic, social, and political challenges. The primary concern lies in the potential erosion of incentives for hard work, innovation, and risk-taking behaviour. In a hypothetical scenario where a brain surgeon receives the same compensation as a garbage collector, the intrinsic motivation to excel and the extrinsic motivation of financial reward would be significantly diminished. This could lead to a phenomenon known as labour shirking, where individuals reduce their effort, and free-riding, where individuals exploit the system without contributing their fair share.

The socioeconomic consequences of egalitarian income distribution could be dire. Work discipline and initiative might plummet, leading to a decline in the overall quality and variety of goods and services produced. Furthermore, technological progress could stagnate due to a lack of motivational drivers for research and development. This stagnation, aptly termed an incentive trap, could have a deleterious impact on a nation's productivity and economic growth. In addition, there are administrative burdens associated with enforcing perfect income equality in nondemocratic regimes. The monetary and temporal costs of top-down monitoring and enforcement mechanisms would likely be significant. Moreover, such attempts at forced equality could foster social unrest and potentially lead to protests, riots, and even political uprisings.

3. Research Methodology

Having established the potential drawbacks of absolute income equality, this analysis paves the way for a more nuanced exploration of the optimal level of income disparity within a nation. Building upon the research presented in the Thammasat Review of Economic and Social Policy (2016), this paper posits the existence of a Goldilocks zone for income inequality, where a measured degree of disparity can coexist with economic dynamism and social cohesion. The next critical step lies in empirically identifying this "just right" level of income inequality for each country. This study proposes a novel hypothesis: a positive correlation between a nation's population size and its optimum Gini coefficient. In simpler terms, the hypothesis suggests that larger populations may be able to tolerate higher levels of income inequality (as measured by the Gini coefficient) without experiencing the same degree of social and economic disruption.

The rationale behind this hypothesis hinges on the concept of socioeconomic heterogeneity. Larger populations are inherently more diverse, encompassing a wider spectrum of skills, professions, and economic opportunities. This diversification fosters specialization within the workforce, which can potentially lead to increased productivity and economic growth. However, this specialization might also contribute to greater income disparities between different segments of the population. Furthermore, larger populations present a greater challenge in terms of equitable resource distribution and ensuring equal opportunities for all citizens. This inherent complexity could lead to higher income inequality, even if overall wealth within the nation increases.

To validate this hypothesis and establish a more robust framework for understanding optimal income inequality, rigorous empirical research is paramount. This research could involve:

Statistical analysis: Employing sophisticated statistical techniques to analyse data from a diverse range of countries with varying population sizes and corresponding Gini coefficients. This analysis would aim to quantify the correlation between population size and the optimum Gini coefficient.

Accounting for confounding factors: While population size is a significant variable, it's crucial to consider the influence of other factors that can influence income inequality. These might include resource distribution policies, prevailing economic systems, and the established cultural norms. By controlling for these factors, the research can isolate the specific impact of population size. For these reasons, this study postulates that the degree of social, economic, and political diversities for any country could be reflected by population heterogeneity in that country. In other words, the information regarding social, economic, and political factors of a given country is already compressed in the data on the number of populations of that country. This would allow us to examine the relationship between the degree of income inequality as measured by Gini coefficient and the size of population by employing ordinary least squares regression, and to find out empirically the level of income inequality as measured by Gini coefficient that is appropriate for the size of population. To examine such a relationship, this study employs income inequality and population data of 103 countries in the years from 2019 to 2023 for which Gini Index and population data are available from the World Bank. Only the latest data of Gini Index during this period of 5 years are taken with the assumption that in absence of the data for all countries for the same year, the Gini index of the latest year remains almost same in these 5 years and vice versa for population.

4. Empirical Results

Figure-3 illustrates scatter plots of the relationship between levels of income inequality as measured by Gini coefficient and natural logarithm of population size. The scatter plots indicate that the relationship between the two variables should be positive. By employing curve fitting technique, this study finds that the relationship between the level of income inequality as measured by Gini coefficient and natural logarithm of population size is nonlinear that can be best described by a second-degree polynomial function.

The following nonlinear equation is therefore employed to estimate the relationship between Gini coefficient and natural logarithm of population size.

$$Gini = \alpha+\beta_1*\ln(Pop)+\beta_2*[\ln(Pop)]^2+\epsilon \qquad ---(1)$$

Where,

$\alpha \# 0$, $\beta_1>0$, $\beta_2<0$ (in negative)

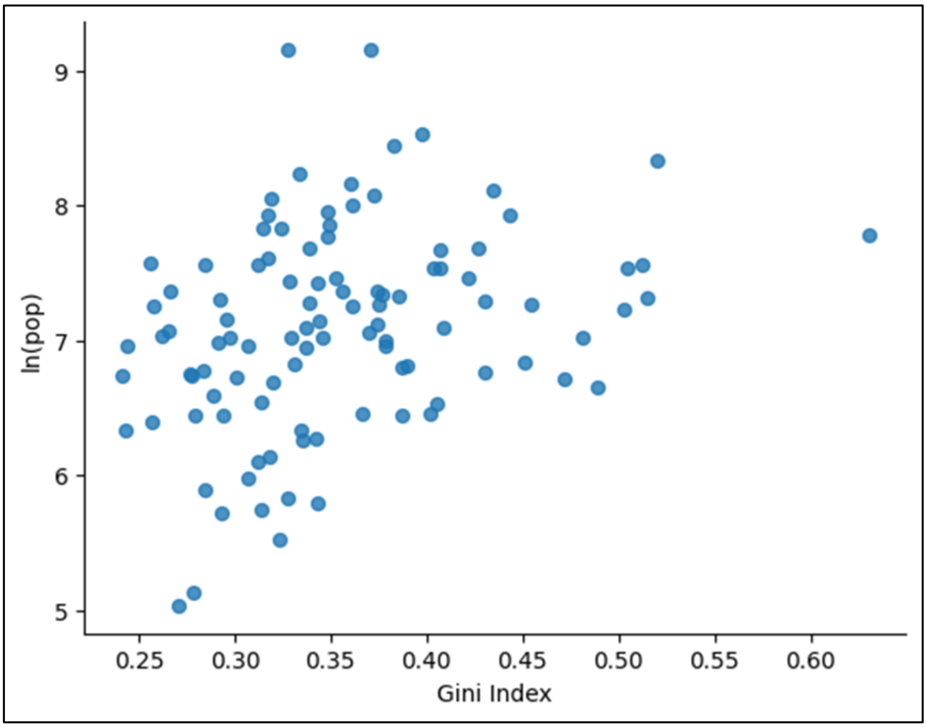

Figure-3.

By using ordinary least squares estimator with heteroskedasticity-consistent standard errors and covariance, the estimated nonlinear relationship between Gini coefficient and natural logarithm of population size is as follows:

Gini Index = - 0.2602 + 0.1453*ln (Pop) + (-) 0.0082*ln (Pop) 2.

OLS Regression Results

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Dep. Variable:	Gini Index	R-squared:	0.109
Model:	OLS	Adj. R-squared:	0.092
Method:	Least Squares	F-statistic:	6.142
No. Observations:	103	Prob (F-statistic):	0.00305
Df Residuals:	100	Log-Likelihood:	132.11
Df Model:	2	AIC:	-258.2
Covariance Type:	nonrobust	BIC:	-250.3

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	coef	std err	t	P>|t|	[0.025	0.975]
const	-0.2602	0.375	-0.694	0.489	-1.004	0.484
ln(Pop)	0.1453	0.106	1.368	0.174	-0.065	0.356
ln(Pop)2	-0.0082	0.007	-1.093	0.277	-0.023	0.007

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Based on the provided regression results:

The overall model is statistically significant, indicating that there is evidence that at least one of the independent variables (`ln(pop)` or `ln(pop)^2`) affects the Gini Index. However, neither `ln(pop)` nor `ln(pop)^2` individually appear to have a statistically significant effect on the Gini Index in this particular model. This conclusion is drawn based on their respective p-values being greater than 0.05. In practical terms, if you were to use this model for prediction or inference, you might consider re-evaluating the inclusion of `ln(pop)` and `ln(pop)^2` or exploring different functional forms or additional variables to better explain the variability in the Gini Index. The following Figure-4 depicts the actual and the predicted values of Gini coefficient.

The positive coefficient of ln (Pop) and negative coefficient of ln(pop)^2 suggest that up to a certain level of population of all countries (differs from country to country) the Gini index increases and then it starts reducing. This shows an inverted "U" relationship between Gini index and population. Hence the point where the curve gets inverted, can be taken as the **possible optimality of Gini Index** for a given population of that country. It can be seen that only in case of a very few countries, the actual Gini Index is equal to their predicted value.

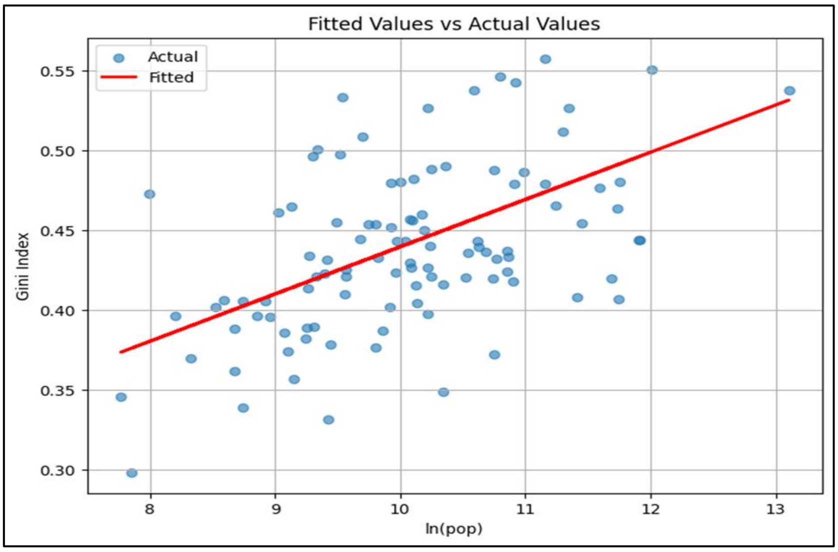

Figure-4.

4.1. Using only ln(Pop) as the independent variable:

Instead of natural logarithm of the population and its square as separate independent variables, if we use only the natural logarithm of population as independent variable, we observe that the

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Dep. Variable:	Gini Index	R-squared:	0.099
Model:	OLS	Adj. R-squared:	0.090
Method:	Least Squares	F-statistic:	11.07
Date:	Wed, 17 Jul 2024	Prob (F-statistic):	0.00123
Time:	03:33:48	Log-Likelihood:	131.50
No. Observations:	103	AIC:	-259.0
Df Residuals:	101	BIC:	-253.7
Df Model:	1		
Covariance Type:	nonrobust		

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	coef	std err	t	P>|t|	[0.025	0.975]
const	0.1437	0.064	2.259	0.026	0.018	0.270
ln(pop)	0.0296	0.009	3.327	0.001	0.012	0.047

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Omnibus:	18.282	Durbin-Watson:	1.686
Prob(Omnibus):	0.000	Jarque-Bera (JB):	22.138
Skew:	0.969	Prob(JB):	1.56e-05
Kurtosis:	4.184	Cond. No.	69.0

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the relationship becomes significant statistically as p value drops to considerably less than 0.05. And the regression equation which is derived therein is as below: -

Regression Equation:

Gini Index = 0.1437 + 0.0296 * ln(pop) -------(2)

4.2. The Case of India

As a test case in search of the optimal value of Gini Index, this study examined the data of Gini Index and population of India from 2009 to 2023. Some of the missing data of Gini Index and population were taken care of as usual. Below is the structured summary of the available data.

Year	Gini Index	Population
2009	34.9	1,22,36,40,160
2010		1,24,06,13,620
2011	35.4	1,25,76,21,191
2012		1,27,44,87,215
2013		1,29,11,32,063
Year	Gini Index	Population
2014		1,30,72,46,509
2015	34.7	1,32,28,66,505
2016	34.7	1,33,86,36,340
2017	35.9	1,35,41,95,680
2018	34.5	1,36,90,03,306

2019	33.8	1,38,31,12,050
2020	33.8	1,39,63,87,127
2021	32.8	1,40,75,63,842
2022		1,41,71,73,173
2023		1,42,86,27,663

The plots in figure-5 show various plots of population and Gini Index of India over time from 2009 to 2023.

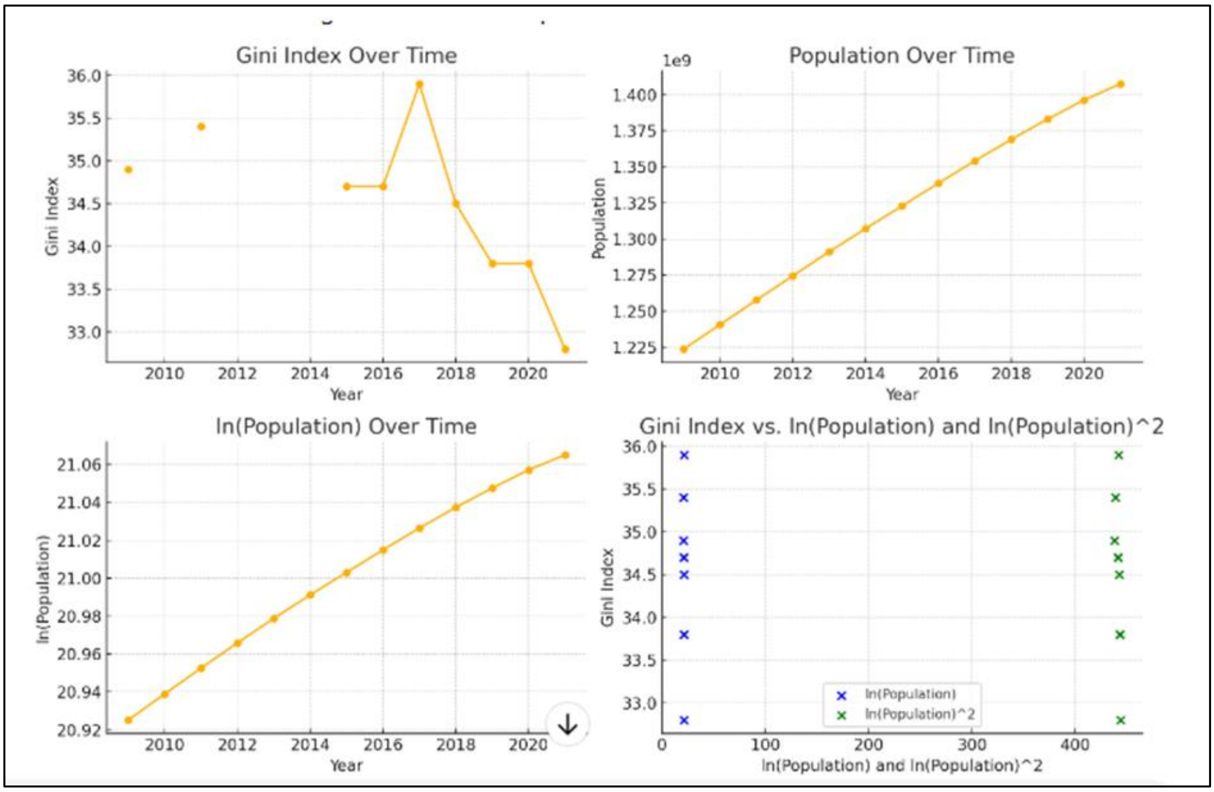

Figure-5.

The results of a similar regression of Gini Index with ln(pop) and ln(pop)^2 are obtained for India as follows: -

Descriptive Statistics

Gini Index

- Count: 9
- Mean: 34.5
- Standard Deviation: 0.927
- Minimum: 32.8
- 25th Percentile: 33.8
- 50th Percentile (Median): 34.7
- 75th Percentile: 34.9
- Maximum: 35.9

Population

- Count: 13
- Mean: 1,320,500,000 (approx.)
- Standard Deviation: 60,521,650 (approx.)
- Minimum: 1,223,640,160
- 25th Percentile: 1,274,487,215
- 50th Percentile (Median): 1,322,866,505
- 75th Percentile: 1,369,003,306
- Maximum: 1,407,563,842

Regression Analysis: -

The regression model is given by:

Gini = $\beta_0 + \beta_1 * \ln(\text{Population}) + \beta 2 * (\ln(Population))^2$

The regression results are:

- **Intercept (β_0): - 127,300.00**
- **Ln(Population) (β_1): 12,140.00**
- **(Ln(Population))^2 (β_2): -289.43**

R-squared: 0.703 (70.3% of the variance in Gini Index is explained by the model)

Turning Point Calculation

The turning point of the quadratic equation is given by:

Turning Point = $- \beta_1/2*\beta_2$

Using the coefficients from the regression:

Turning Point = 12,140.00/2*-289.43 = 20.975

The turning point represents the value of the natural logarithm of the population at which the Gini Index is at its maximum or minimum. Since β_2 is negative, the parabola opens downwards, indicating a maximum point. This suggests that there is an optimal population level (in logarithmic terms) at which the Gini Index, a measure of inequality is at its highest.The turning point of 20.975 corresponds to a specific population size when converted back from logarithmic scale. It comes to almost 129 crores of population, a point where the Gini Index is the maximum.

However, this does not mean that countries that have the levels of income inequality as measured by Gini coefficient equal or close to the appropriate levels should stay passive. It is possible that, given approximately equal sizes of population and Gini coefficients, the ratio of income share held by the rich to the income share held by the poor in one country is much higher than that of the other country. In this case, the former country should come up with public policies in order to reallocate income among populations by increasing income of the poor and at the same time reducing income of the rich in such a way that the targeted or appropriate level of income inequality remains unchanged.

5. Conclusion and Policy Implications

The prevailing discourse on income inequality has primarily revolves round the imperative to mitigate the disparity between the most affluent and the least. This research posits a paradigm shift, contending that there may exist an optimal level of income inequality conducive to flourishing economic growth and societal well-being.

The current policy landscape is demonstrably deficient in its approach to income inequality. Policymakers frequently advocate for the reduction of inequality without a clearly delineated target or an empirical understanding of the potential consequences. This study underscores the exigency for a more nuanced comprehension of income distribution.

We leverage a comprehensive dataset encompassing population size and Gini coefficients (a metric for quantifying income disparity) for a substantial sample of countries (n=103). The analysis posits a correlation between a nation's proximity to its "appropriate" level of income inequality and its economic and social performance.

Furthermore, this research challenges the conventional focus on the income disparity between the most and least affluent segments of society. We posit that the income differential between the richest and the second-richest individuals might be a more germane factor. The theoretical rationale underpinning this proposition centres on the potential for societal destabilization when the income (or wealth) of the top earners surpasses a critical threshold relative to the second-richest group. This scenario could engender feelings of unfairness among the latter group, while simultaneously inciting anxieties among the top earners regarding potential threats to their economic, social, and political standing. Both groups, wielding significant resources, could engage in manoeuvres designed to manipulate government policies, circumvent regulations, and sway public opinion, thereby fomenting social discord. The empirical validation or refutation of this hypothesis constitutes a compelling avenue for future research.

Finally, this study underscores the necessity for further investigation into the identification of equitable income distribution within societal subgroups. The ultimate objective is to ascertain a framework for income distribution that engenders a widespread sense of fairness amongst all members of society. These intriguing inquiries beckon further exploration in subsequent research endeavours.

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