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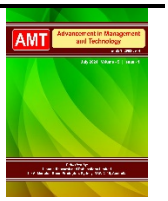

Original Article

Analysis on Economic Inequality in India

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Abstract:

The paper examines income inequality in India from 1951 to 2022, highlighting trends and nonlinear patterns in the top 10% and bottom 50% income shares of national income, as well as the gap between these shares. The analysis employs semi-log and double log regression models, the HP filter model, the Hamilton regression filter model, and the ARIMA (p, d, q) forecast model. The findings indicate that the top 10% income share increased steadily, while the bottom 50% share decreased monotonically. The gap between these shares narrowed until the 1980s, after which it widened. All trends are cyclical, with identifiable peaks and troughs. GDP has less influence than GDP per capita on the top 10% income share increase, while the reverse is true for the bottom 50%. The nature of the gap is U-shaped, with a 1% annual increase in GDP and GDP per capita leading to a 0.33% and 0.45% increase in the gap, respectively. The ARIMA (2,1,2) forecast model for the income share gap in 2050 suggests a convergence towards equilibrium in a stable manner, although it remains nonstationary due to an insignificant Moving Average process. This implies that inequality will not completely disappear by 2050. Policy recommendations are proposed for future discussions.

Keywords: *Economic Inequality; Top10% Income Share; Bottom 50% Income Share; Gap of Income Share Top10% And Bottom 50%; ARIMA Forecast Model*

JEL Codes- *D31; N35; O15*

Introduction

In 1820, the global income shares of the top 10% was 18 times greater than that of the bottom 50%. By 1910, this disparity had increased to 41 times and reached 53 times in 1980. Following this peak, there was a steady decline, with the ratio reaching 38 times in 2020. The Gini index of global inequality was 0.60 in 1820, simultaneously rising to 0.72 in both 1910 and 2000, before starting to decline and reaching 0.67 in 2020 (Chancel & Piketty, 2021). Between 1820 and 1910, global inequality between countries was rising at an accelerated rate, while within-country inequalities were very high and increasing slowly. From 1910 to 1980, within-country inequality largely declined, primarily due to political mobilization and institutional changes, especially the balance of power shifts between 1914 and 1945. During the period from 1980 to 2020, between-country inequality rose from 1980 to 1990 due to socialism in China and Russia. However, it reached a plateau following the financial crisis in 2008 (World Inequality Report, 2022).

Income inequality in India has been historically persistent. During the British rule from 1858 to 1947, income inequality was very high, with the top 10% holding 50% of the income share. After independence, this share reduced to 35-40%. The average national income of the Indian adult population is Rs 204,200, with the bottom 50% earning Rs 53,610 and the top 10% earning more than 20 times of that amount, at Rs 1,166,520. The top 10% and top 1% hold 57% and 22% of the total

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national income, respectively, while the share of the bottom 50% has decreased to 13%. As a result, India is characterized as a poor and unequal country (World Inequality Report, 2022).

Banerjee and Piketty (2001) showed that the real income of the top 1% of income earners in India increased by about 50% in the 1990s. The richest 1% saw their real incomes more than triple during this period, resulting in a U-shaped pattern in income share due to economic policy. Lawson and Martin (2018) reported that in 2018, India ranked 147th out of 157 countries in terms of commitment to reducing inequality and 95th out of 157 countries in terms of income distribution inequality, with a Gini index of 35.2 in 2011. Stoller (2020) found that the number of billionaires in India increased by 108%, reaching 102 billionaires from 2010 to 2020, while 30 million people fell below the poverty line.

In 2000, India's wealth share of the top 1% was 33.2%, which increased to 41% in 2022. The total number of millionaires in India rose from 37,000 in 2000 to 849,000 in 2022, and is expected to reach 1,436,000 by 2027. India's total wealth in 2022 was $15,365 billion USD, which represents a growth of 4.6%. The wealth inequality Gini index in India was 82.5 in 2022, compared to 70.9 in China (Credit Suisse Research Institute, 2023).

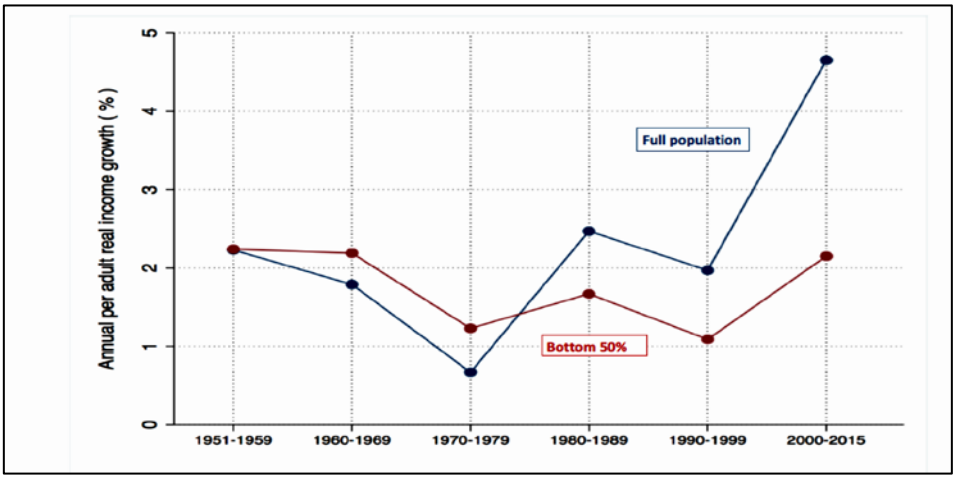
In 2002, the bottom 10% of households in India held 0.3% of the wealth, which decreased to -1.3% in 2012. The bottom 20% held 1.0% of the wealth in 2002, falling to -0.9% in 2012, while the bottom 30% held 2.5% in 2002, which decreased to 0.1% in 2012. Conversely, the top 10% held 52.9% of the wealth in 2002, increasing to 62.1% in 2012, and the top 1% held 15.7% in 2002, which rose to 25.7% in 2012. As of 2022, the top 10% hold 72.5% of the wealth in India, compared to 61.7% for the top 5% and 40.6% for the top 1% (Credit Suisse Research Institute, 2022).

Thus, high income inequality has been evident in India for a long period due to unequal income and wealth holdings. This paper endeavors to evaluate and re-examine economic inequality in India from 1951 to 2022 through econometric analysis and to address related policy issues.

Important Researchs

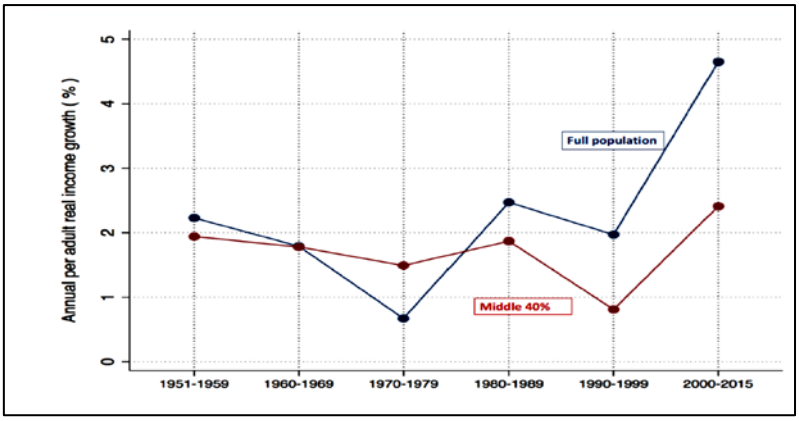
In the last decade, significant research has been conducted on income inequality in both the global economy and individual economies, yielding valuable findings. The major research outcomes are included here for explanation.

Chancel and Piketty (2017) found out that the income share of bottom 50% grew at a lower rate than the average since 1980s and the same is true for middle 40% while top10% and top 1% grew at faster rate than the average in India during 1951-2015. (Figure 1, 2, 3).



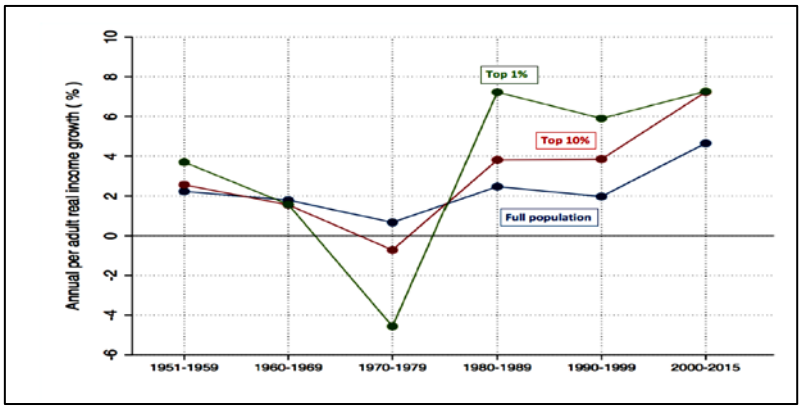
Source: Chancel and Piketty (2017)

Figure 1: National Income Growth in India: Full Population vs Bottom 50% Income Group, 1951-2015



Source: Chancel and Piketty (2017)

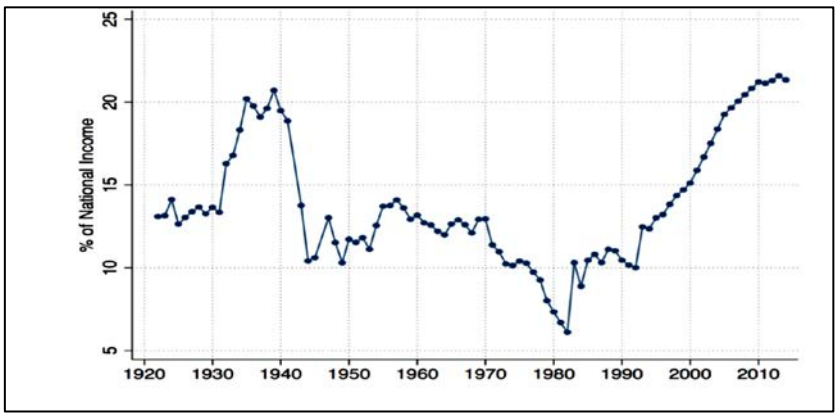
Figure 2: National Income Growth in India: Full Population vs Middle 40% Income Group, 1951-2015



Source: Chancel and Piketty (2017)

Figure 3: National Income Growth in India: Full Population vs Top 1% and 10% Income Group, 1951-2015

The share of national income of top1% was 6.2% in 1982-83 and reached to 13% in 1922-23 and finally captured 21.3% in 2014-15. It was 20.7% in 1939-40 but declined to 10.3% in 1949-50 (Figure 4).



Source: Chancel and Piketty (2017)

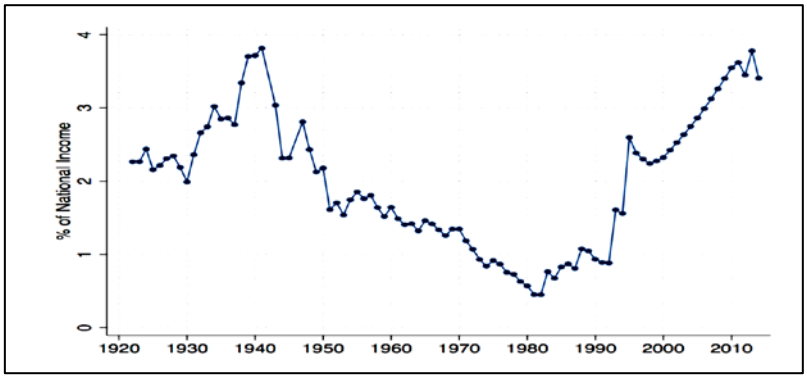
Figure 4: Top 1% National Income Share in India, 1922-2015

The income shares of top 0.1% was 8.9% in 1939-40 which fell down to 5.5% in 1944-45 and further declined to 1.7% in 1982-83 but finally reached to 8.2% in 2014-15 (Figure 5).

Source: Chancel and Piketty (2017)

Figure 5: Top 0.1% National Income Share in India, 1922-2015

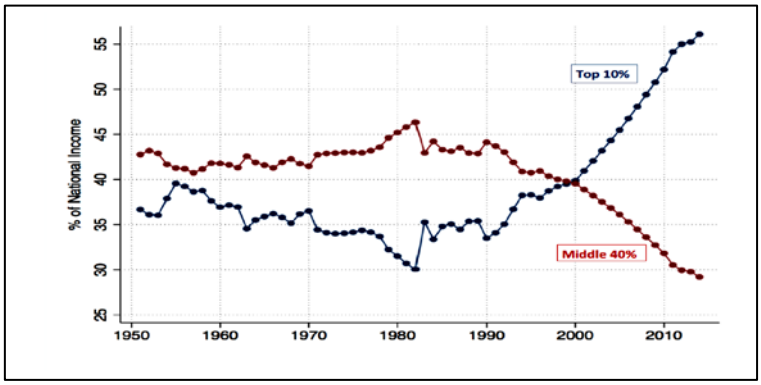
In 1941-42, the income shares of top 0.01% was 3.8% which declined to 0.4% in 1982-83 and reached to 3.4% in 2014-15 (Figure 6).



Source: Chancel and Piketty (2017)

Figure 6: Top 0.01% National Income Share in India, 1922-2015

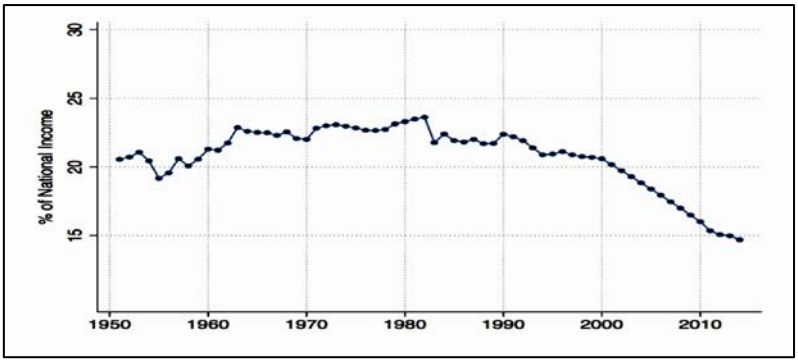
In the post-independence period, the income shares of top 10% showed many ups and downs ranging from 32-39% till 1990 and then it increased steadily up to 56% in 2014-15 while the middle 40% captured 40-46% share during 1950-1990 followed by a steady decline to a low of 29.2% in 2014-15 (Figure 7).



Source: Chancel and Piketty (2017)

Figure 7: Top 10% vs Middle 40% National Income Share in India, 1951-2015

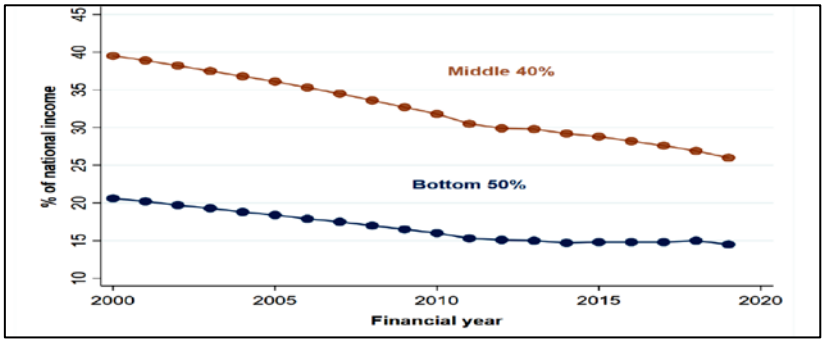
The income dynamics of the bottom 50% share of national income increased from 19% in 1955-56 to 23.6% in 1982-1983, but then decreased sharply and almost continuously thereafter reached to 20.6% in 2000-2001 and 14.9% in 2014-15 (Figure 8).



Source: Chancel and Piketty (2017)

Figure 8: Bottom 50% National Income Share in India, 1951-2015

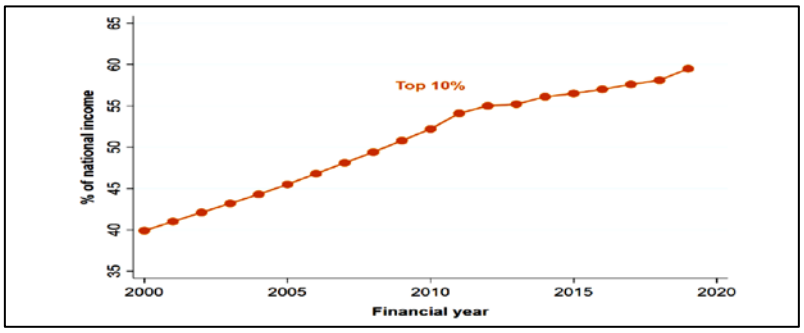
Based on the data from Chancel and Piketty (2017), Somanchi (2023) estimated the dynamics of the share of national income in India from 2000 to 2020 and found that top 10% has risen from 39.9% in 2000-01 to 59.5% in 2019-20 while the share of the top 1% has grown from 15.1% to 25.1% over the period. In Figure-9, the share of bottom 50% and middle 40% have been monotonically declining from 2000 to 2020 where the share of the bottom 50% dwindled from just over 20% in 2000 to 15% by 2011 and has remained stagnant there till 2020 which is very low and the lowest in the world (Figure 9).



Source: Chancel and Piketty (2019)

Figure 9: Bottom 50% and Middle 40% Income Shares

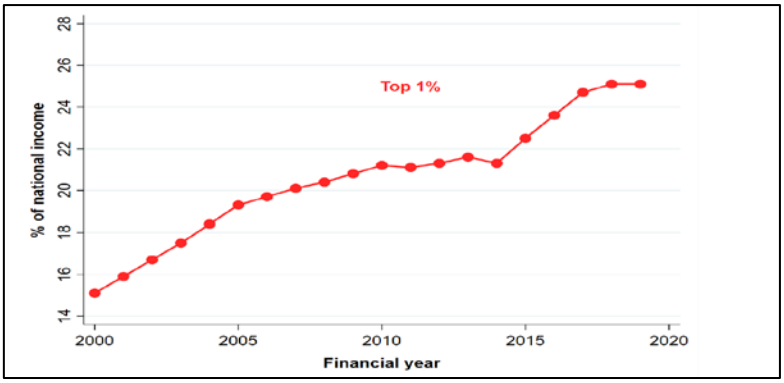
In Figure 10, the top 10% share rose to 55% in 2011 and reached to 60% in 2020 which is the highest in the world.



Source: Chancel and Piketty (2019)

Figure 10: Top 10% Income Share

In Figure 11, it is seen that top 1% share increased to 22% in 2014 from 15% in 2000 and further rose to 25% in 2020 which implies that a wealth concentration was evident.

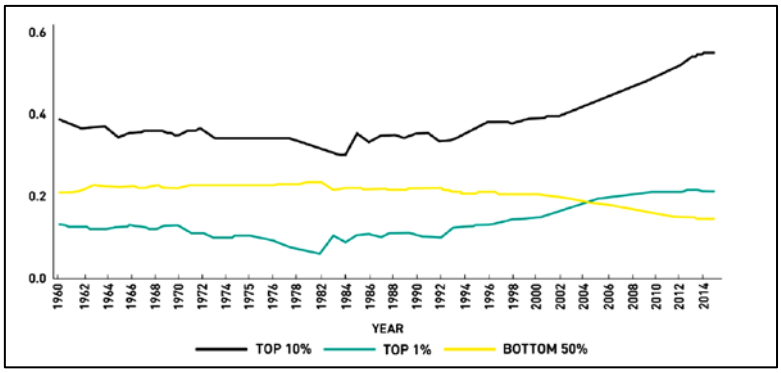


Source: Chancel and Piketty (2019)

Figure 11: Top 1% Income Share

Authors found that between 2000-01 and 2019-20, income share of the top 10% rose by 50% from 40% to nearly 60%. Even more so, the income shares of the top 1% increased by two-thirds from 15.1% to 25.1%. It means that the top 10% captured as much as 67.8% of the aggregate national income growth (real-terms) between 2000 and 2020 with the top 1% alone capturing nearly as much as the entire bottom 90% did.

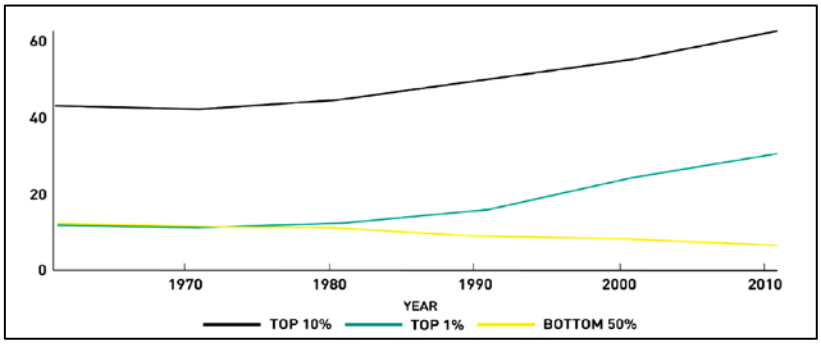
Chancel and Piketty (2019) saw that income share between bottom and top earners narrowed during 1951-1980 which was reversed during 1980-2014 because top 1% share has been increasing and reached at 22% but income share of bottom 50% fell to 14.7% (Figure 12).



Source: John (2020)

Figure 12: Income Inequality in India

Chancel and Piketty (2019) found that India's Gini coefficient for wealth increased from 0.67 in 2001-02 to 0.75 in 2012.The wealth inequality has worsened between 1980 to 2014. Figure 10 indicates that the wealth share of the bottom 50% was higher than that of the top 1% in the 1960s and 70s. Presently, the wealth share of the top 1% is six times more than that of the bottom 50% (Figure 13).



Source: John (2020)

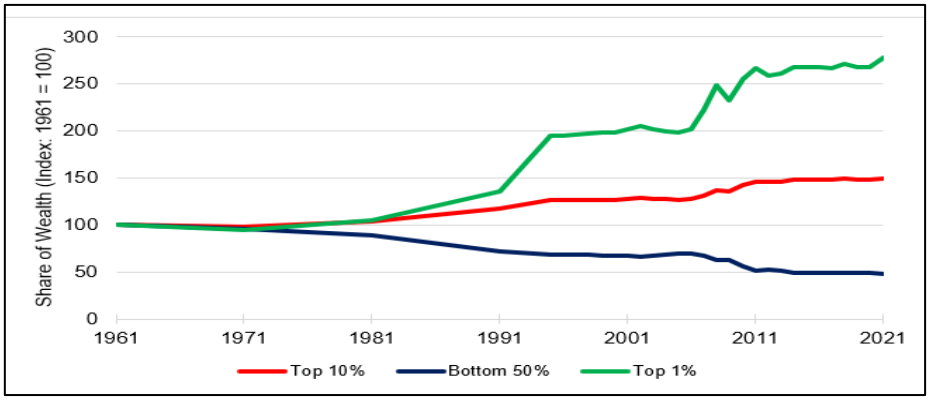
Figure 13: Wealth Inequality in India

Ghatak, Raghavan and Xu (2022) showed that the share of wealth of bottom 50% have been declining successively decade-wise since 1960 in India as per World Inequality Data while top 10% and top 1% have been consistently increasing where the top 10% group has taken up more than 60% of the total wealth and bottom 50% shared only 6% in recent years (Table 1 and Figure 14).

Table 1: Average Share of Wealth by Economic Group in India, 1961-2020

Year	Average share of wealth of bottom 50%	Average share of wealth of top 10%	Average share of wealth of top 1%
1961-1970	12.29%	43.18%	11.87%
1971-1980	11.75%	42.25%	11.23%
1981-1990	10.91%	45.00%	12.50%
1991-2000	8.36%	54.57%	23.31%
2001-2010	8.10%	56.60%	25.70%
2011-2020	6.12%	63.68%	31.55%

Source: Ghatak, Raghavan & Xu (2022)



Source: Ghatak, Raghavan & Xu (2022)

Figure 14: Wealth Inequality in India , 1961-2021

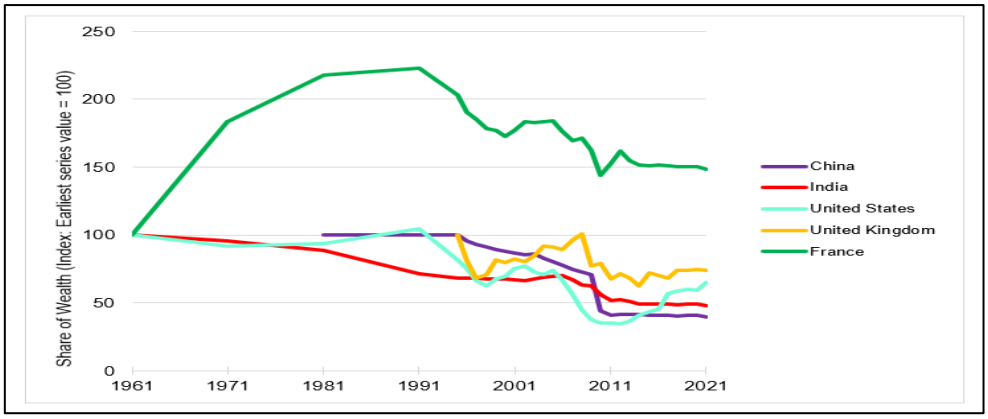
It is showed in Table 2 that top 1% and top 10% have experienced faster wealth accumulation than the bottom 50%, especially at the turn of the 21st century while wealth growth significantly slowed down after 2010, from a growth rate of roughly 8% in 1995-2010 to 5% in 2011-2020.

Table 2: Growth Rate of Wealth by Economic Group in India, 1995-2020

Year	**Average Annual Growth Rate of Net Personal Wealth**	**Average Annual Growth Rate of Net Personal Wealth of Bottom 50%**	**Average Annual Growth Rate of Net Personal Wealth of Top 10%**	**Average Annual Growth Rate of Net Personal Wealth of Top 1%**
1995-2000	8.10%	8.02%	8.16%	8.24%
2001-2010	8.17%	7.39%	8.66%	9.26%
2011-2020	5.77%	5.16%	5.95%	5.97%

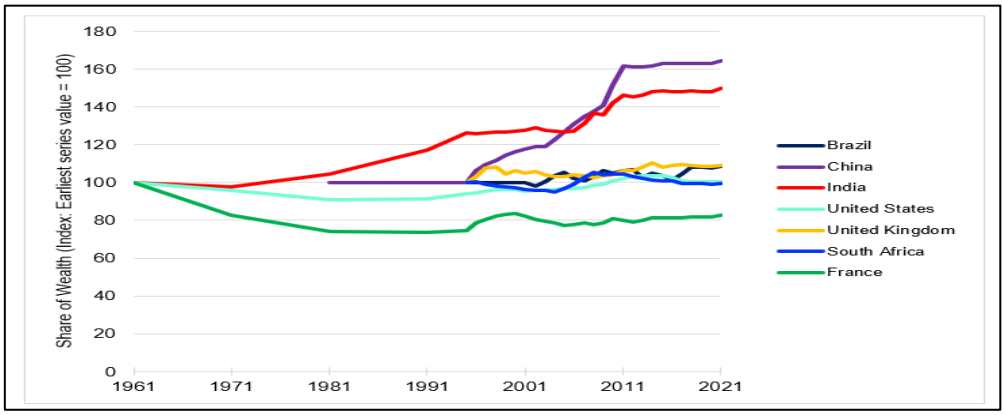
Source: Ghatak, Raghavan & Xu (2022)

In India, the share of the wealth of the bottom 50% has nearly halved since 1961 (Figure 15) in comparison to that of the share of wealth of the top 10% has increased by around 50% (Figure 16) and the share of wealth of the top 1% has increased by around 180% since 1961 (Figure 17). India has experienced the largest increase in the share of wealth of the top 1% since 1961. However, even in terms of other measures (such as the share of the bottom 50% and the top 10%), it is at the top of the list, with only China being slightly ahead.



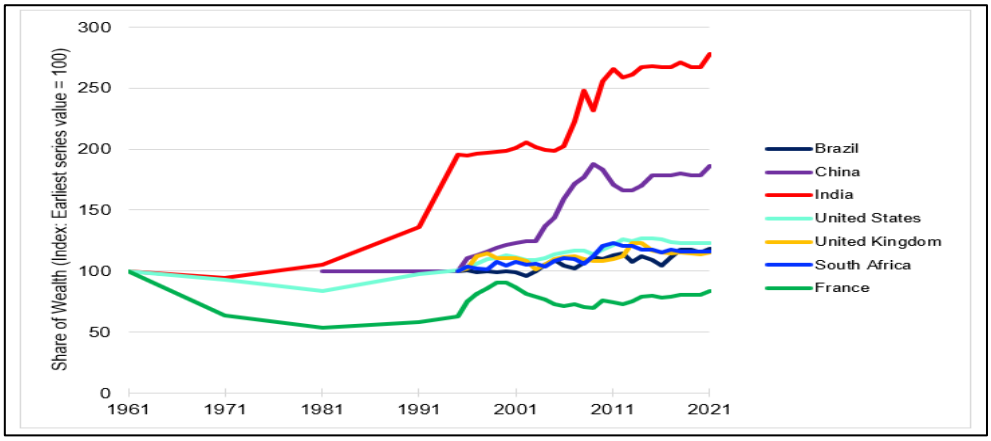
Source: Ghatak, Raghavan & Xu (2022)

Figure 15: Share of Wealth Held by Bottom 50%, 1980-2021



Source: Ghatak, Raghavan & Xu (2022)

Figure 16: Share of Wealth Held by Top 10%, 1980-2021



Source: Ghatak, Raghavan & Xu (2022)

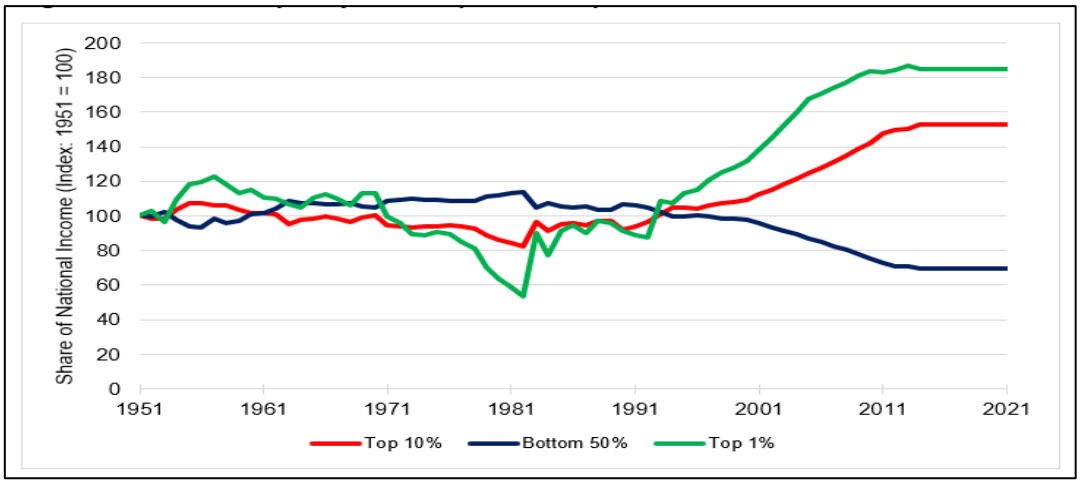
Figure 17: Share of Wealth Held by Top 1%, 1980-2021

Table 3 represents the average share of national income held by the bottom 50%, top 10%, and top 1% of the population by decade. During 1951-1990, the share of income of top10% and top1% have been successively decreased but share of income of bottom 50% has increased followed by the reversed results in all the three cases i.e., bottom 50% share decreased, top10% and top 1% share have increased (Figure18).

Table 3: Average Share of Income by Economic Group in India, 1951-2020

Year	Average Share of Income of Bottom 50%	Average Share of Income of Top 10%	Average Share of Income of Top1%
1951-1960	18.56%	38.62%	13.13%
1961-1970	20.10%	36.98%	12.91%
1971-1980	20.75%	34.62%	10.05%
1981-1990	20.24%	34.69%	9.87%
1991-2000	19.08%	38.75%	13.26%
2001-2010	16.26%	47.37%	19.42%
2011-2020	13.25%	56.74%	21.74%

Source: Ghatak, Raghavan & Xu (2022)



Source: Ghatak, Raghavan & Xu (2022)

Figure 18: Income inequality in India, 1951-2021

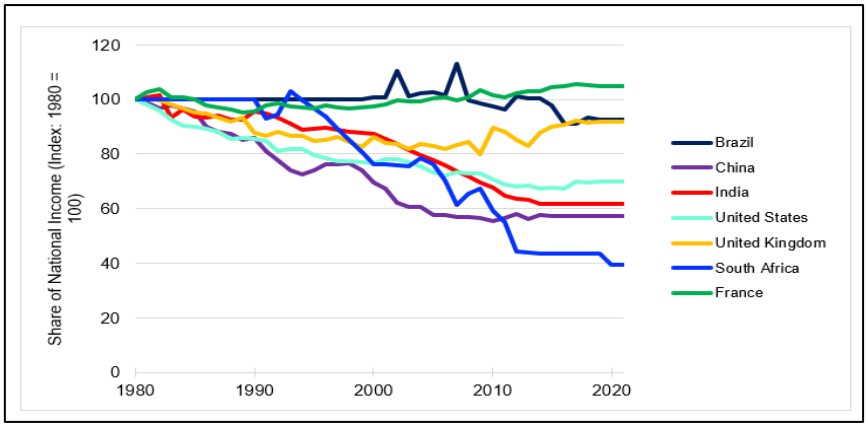
During 1951-1980, the average annual growth rate of bottom 50%, top10% and top 1% have been declined and then catapulted up to 2010 followed by successive decline (Table 4).

Table 4: Growth Rate of Income by Economic Group in India, 1951-2020

Year	Average Annual Growth Rate of National Income	Average Annual Growth Rate of Income of Bottom 50%	Average Annual Growth Rate of Income of Top 10%	Average Annual Growth Rate of Income of Top 1%
1951-1960	4.31%	4.36%	4.38%	4.99%
1961-1970	3.97%	4.14%	3.93%	3.90%
1971-1980	3.02%	3.31%	2.37%	0.55%
1981-1990	5.45%	5.25%	5.71%	6.98%
1991-2000	5.69%	5.31%	6.45%	7.29%
2001-2010	6.67%	5.55%	7.82%	8.12%
2011-2020	5.35%	4.97%	5.66%	5.37%

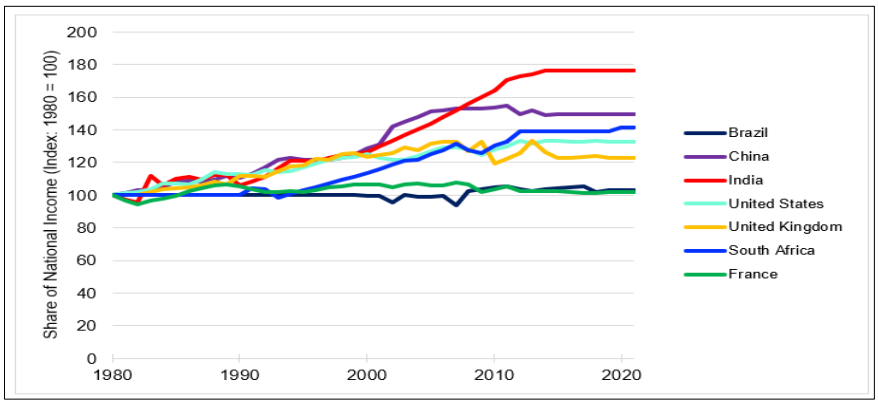
Source: Ghatak, Raghavan & Xu (2022)

In India, the share of the national income of the bottom 50% has decreased by around 40% since 1980 (Figure 19) along with USA and South Africa while UK, France and China have been rising. In contrast, the share of the national income of the top 10% has increased by around 80% (Figure 20) similarly with UK, South Africa and China while France and Brazil could not. The share of the top 1% has increased by around 180% since 1980 (Figure 21) along with China and UK while France and Brazil failed to do so. India has experienced the largest increase in share of the national income of the top 1% and top 10% since 1980 comparing with others while China and South Africa also witnessed a widening income gap between the rich and the poor.



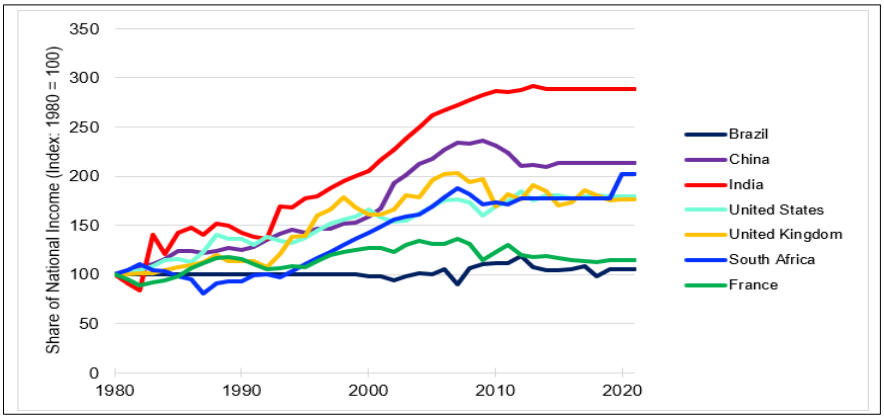
Source: Ghatak, Raghavan & Xu (2022)

Figure 19: Share of National Income of Bottom 50%, 1980-2021



Source: Ghatak, Raghavan & Xu (2022)

Figure 20: Share of National Income of Top 10%, 1980-2021



Source: Ghatak, Raghavan & Xu (2022)

Figure 21: Share of National Income of Top 1%, 1980-2021

Solanki (2022) studied the inequalities among SC, ST, OBC, Muslims, FC and other communities in India comparing between the periods of 2002 and 2012. It was found that caste disparity led to economic inequality. The degree of wealth and consumption inequality within lower castes has increased.

The fact is that the adult population of India earns an average national income of €PPP7,400 (or INR 204,200). The bottom 50% gets €PPP2000 (INR 53,610), while the top 10% make €PPP 42 500 (INR 1,166,520), which is more than 20 times. The bottom 50% share has decreased to 13%, while the top 10% and top 1% hold respectively 57 and 22% of the nation's total revenue (World Inequality Report-2022).

The average household income in India is $9, 435/month. The ST and SC groups' annual incomes are respectively 0.7 and 0.8 times lower than the average income for all of India. The household income of OBC and Muslims are roughly 0.9 times higher than the national average. The average household income for the Forward Castes (FC), with a small difference between Brahmin and Non-Brahmin households, is 1.4 times of the average income for all of India. Based on average income, there is sequential inequality with the following rankings: ST, SC, Muslim, OBC, Over all FC (Non-Brahmin), FC (Brahmin) and others trend.

It was noted that the top 10% and middle 40% of the population, where nearly 90% of the wealth is concentrated, have a disproportionately higher presence of FC. Muslims, SCs, and STs are disproportionately more prevalent in the Bottom 50%. All wealth deciles have an equal distribution of OBCs. Regarding the relative wealth share, the representational inequality is unaffected (Table 5).

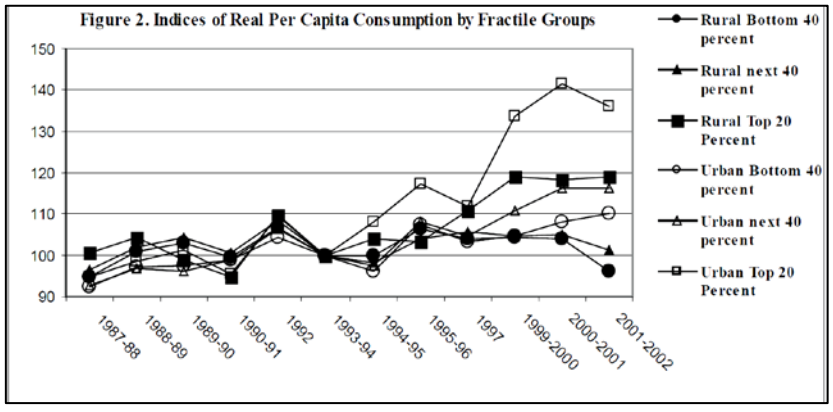
Table 5: Representational Inequalities

		2002			2012		
	Caste Group/Deciles	**Bottom 50%**	**Middle 40%**	**Top 10%**	**Bottom 50%**	**Middle 40%**	**Top 10%**
INDIA	ST	0.36	-0.32	-0.72	0.4	-0.36	-0.75
	SC	0.37	-0.31	-0.81	0.32	-0.26	-0.79
	OBC	-0.03	0.06	-0.21	-0.05	0.08	-0.17
	FC	-0.34	0.27	0.91	-0.3	0.21	0.98
	Muslim	0.19	-0.14	-0.51	0.12	-0.07	-0.46
	Others	-0.63	0.05	4.58	-0.58	0.01	4.4
RURAL	ST	0.34	-0.33	-0.71	0.34	-0.32	-0.76
	SC	0.35	-0.34	-0.84	0.28	-0.26	-0.75
	OBC	-0.06	0.08	-0.09	-0.1	0.12	-0.04
	FC	-0.38	0.37	0.89	-0.27	0.22	0.94
	Muslim	0.18	-0.17	-0.45	0.11	-0.06	-0.57
	Others	-0.71	0.05	6.88	-0.6	-0.11	7.44
URBAN	ST	0.34	-0.28	-0.45	0.34	-0.29	-0.45
	SC	0.37	-0.25	-0.75	0.36	-0.23	-0.81
	OBC	0.07	-0.01	-0.32	0.06	-0.01	-0.27
	FC	-0.24	0.15	0.57	-0.28	0.17	0.67
	Muslim	0.22	-0.12	-0.61	0.24	-0.16	-0.49

Source: Bharti, 2018

Pal and Ghosh (2007) claim that inequality has decreased in the post-liberalization period but during 50-55th NSS round i.e., from 1993-94 to 1999-2000, the inequality has increased in rural and urban areas in India.

Sen and Himanshu (2004) pointed out that rural inequality increased during 50-55th NSS round i.e., from 1993-1994 to 1999-2000 which was concluded by Deaton and Dreze (2002) and Sundaram and Tendulkar (2003) where Mean Per Capita Expenditure (MPCE) of top 20% of population went up but bottom 80% population declined (Figure 22).



Source: Sen and Himanshu (2004)

Figure 22: Indices of Real Per Capita Consumption by Fractile Groups

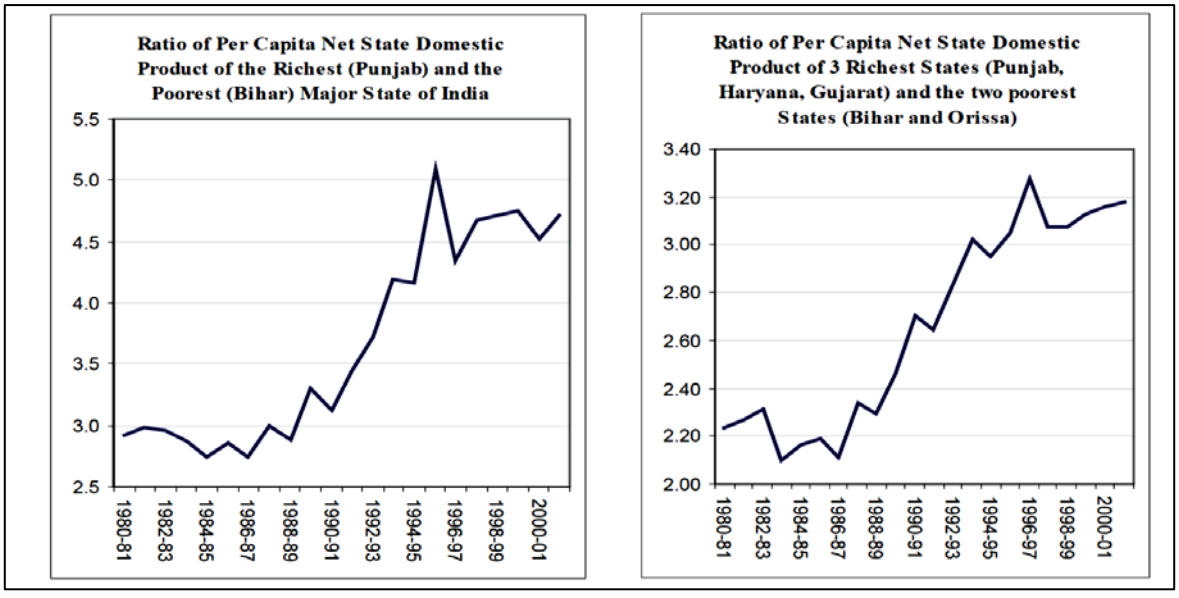
In 50-55th round, Gini coefficients of rural sector in 8 states declined while 7 states have increased and in 15 states urban inequality increased from 1993-94 to 1999-2000 which is seen in Table 6.

Table 6: Gini-Coefficients

	Rural		Urban	
	50th Round	**55th Round**	**50th Round**	**55th Round**
Andhra Pradesh	24.9	23.8	30.3	31.7
Assam	17.6	20.3	28.3	31.2
Bihar	20.9	20.8	29.7	32.3
Gujrat	22.3	23.8	26.9	29.1
Haryana	26.9	25.0	26.7	29.2
Karnataka	24.3	24.5	30.4	33.0
Kerala	27.2	29.0	32.3	32.7
Madhya Pradesh	25.0	24.2	29.7	32.2
Maharashtra	26.7	26.4	33.5	35.5
Orissa	22.4	24.7	29.4	29.8
Punjab	23.8	25.3	26.5	29.4
Rajasthan	23.5	21.3	26.8	28.7
Tamil Nadu	28.2	28.4	32.8	39.1
Uttar Pradesh	25.2	25.0	30.2	33.3
West Bengal	23.8	22.6	32.7	34.3
All India	25.8	26.3	31.9	34.8

Source: (Sen and Himangshu,2004) using 50th and 55th NSS survey

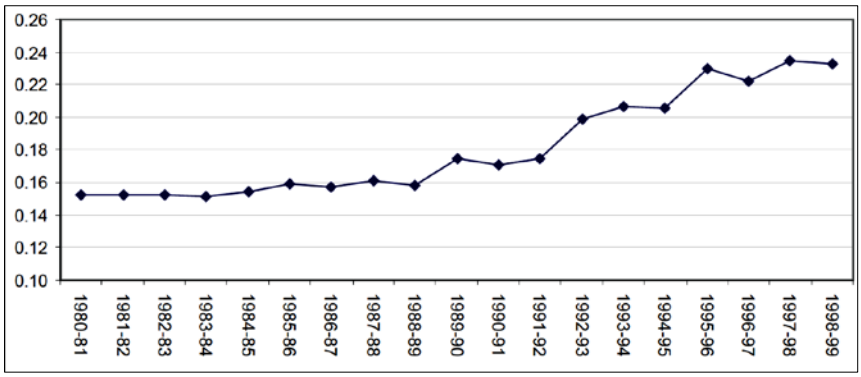
Ghosh and Chandrasekhar (2003) showed that the per capita Net State Domestic Product (NSDP) of the richest state, Punjab, was about 4.7 times that of Bihar, the poorest state in 2002-03 from 1993-94 where the ratio was 4.2. Disparity between the richest and poorest state sprang up remarkably during the 1990s (Figure 23).



Source: Banerjee & Piketty,2001

Figure 23: Widening Disparity between the Richest and the Poorest States

Ahluwalia (2001) also indicated the trend of increasing inequality among states by using per capita gross state domestic product data for the period 1980-1981 to 1998-1999. In Figure 24, the trend of the Gini coefficient of inter-state inequality is shown, which confirms that inter-state inequality grew steadily in India during the era of liberalization.



Source: Ahluwalia (2001)

Figure 24: Trend in Inter-State Inequality, Gini Coefficient

The estimates of Bharti *et al*. (2024) suggest that inequality declined in India from post-independence period to the early 1980s, after which it began to rise and has accelerated since the early 2000s. Between 2014-15 and 2022-23, the rise of top-end inequality has been particularly pronounced in terms of wealth concentration. By 2022-23, top 1% income and wealth shares (22.6% and 40.1%) reached at the highest historical levels and India's top 1% income share was proved to be the highest in the world.

Hai Anh Dang and Lanjouw (2018) emphasised that large number of income mobility has been rising who have engulfed into poverty in recent decades remain vulnerable. Presently, large number of poor are long term poor. Thus, poverty reduction policy became difficult where India fails to overcome structural factors which prevent the chronically poor from escaping poverty. Besides, India's intergenerational mobility is low and shows no clear sign of rising which implies pervasive inequalities of opportunity. If it is tackled then social justice would be better off that will stimulate inequality-dampening inclusive growth via rising education levels, particularly amongst the poor.

Objectives

The purpose of the paper is to study the income inequality in India explaining the top10% and bottom 50% national income share especially during 1951-2022 using the trends and patterns and finding relations between GDP and GDP per capita. It also finds out the patterns of gap between the two income shares and its forecast for 2050 through the ARIMA model which passed through the Hamilton regression filter. The basic results of the study show an extension of the previous researches which are reviewed here extensively. Some policy recommendations have been prescribed for further discussions.

Methodology

Sources of data

The data of top10% national income share and bottom 50% national income share in India from 1951 to 2022 have been obtained from the World Inequality Data Lab. The data on Gross Domestic Product and Gross Domestic Product per capita in current US$ from 1960 to 2022 have been taken from the World Bank.

To find out the trend line, the semi-log linear regression model was used. It can be expressed as

$Log(x_i)=\alpha+\beta t+u_i$

Where x_i= variable, t is the time, u_i= random error, i=1,2,3…..n, α and β are constants to be estimated.

The relationship between two variables, the double log regression model was applied as below.

$Log(x_i)= \alpha+\beta log(y_i)+u_i$, where x_i and y_i are the respective variables for i=1,2,3,……n

H.P.Filter (1997) model was used for decomposing into trends and cycles which is expressed as below.

$y_t=\tau_t+c_t+\varepsilon_t$

where y_t is a time series.

t = 1, 2, 3,…..,T

τ_t = trend component

c_t = cyclic component

ε_t = noise component

H.P.Filter model is given by

$HP=[\lambda L^2-4\lambda L+(1+6\lambda)-4\lambda L^{-1}+\lambda L^{-2}]^{-1}$

Where λ is a multiplier, for quarterly data λ=1600, for yearly data, λ=100, L is a lag operator.

To find out ARIMA (p, d, q) model, the Box and Jenkins (1976) methodology was applied which can be expressed as below.

$x_t= a+ b_ix_{t-i}+ \varepsilon_t+ b_{oi}\varepsilon_{t-i}+ è_t$ where x_t is the variable, a is constant, b_i are the coefficients of AR process and b_{oi} are the co-efficients of MA process and $è_t$ is residual and i=1,2,…….n, and t= time. If b_i and b_{oi} are less than zero and significant at 5% level then the model is convergent and significant. If the roots of AR and MA are less than one and significant then the model is stable and stationary.

Hamilton regression filter (2018) was used to explain the decomposition of trends, cycle and seasonality of a series which can be written as below.

$v_t= x_t- (\widehat{\alpha} + \bar{\beta}_1 x_{t-8}+ \bar{\beta}_2 x_{t-9}+ \bar{\beta}_3 x_{t-10}+ \bar{\beta}_4 x_{t-11})$ where $\widehat{\alpha}$ and $\widehat{\beta}$ i are estimated. This residual v_t is then decomposed into trend, cycle and seasonality by STL method stated by Cleveland *et al*. (1990). Hamilton suggested h=8 for business cycles and h=20 for studies in financial cycles. Regression v_t converges in large samples to $\widehat{\beta}_i$=1 and all other $\widehat{\beta}_j$ =0. Thus, the forecast error is $v_{t+h}=x_{t+h} -x_t$ where x_t applies random walk: $x_t=x_{t-1}-\varepsilon_t$ where $\omega_t^h=\varepsilon_{t+h}+\varepsilon_{t+h-1}+……+\varepsilon_{t+1.}$

Results

India's national income share of bottom 50% had been declining at the rate of 0.5039% per year from 1951 to 2022 significantly. The estimated trend equation is given below.

$Log(b_{50}) = -1.419-0.005039t +u_i$

(-55.47)*(-8.81)*

Where R^2=0.526, F=77.71*, DW=0.0513, SC=-1.51, AIC=-1.58, n=72, *=significant at 5% level. b_{50}=income share of bottom50%, t=year, u_i=random variable.

Hamilton (2018) regression filter equation of bottom 50% share from 1960 to 2022 in India is estimated below.

$(b_{50})_t=0.0017+1.529(b_{50})_{t-8}+0.0121(b_{50})_{t-9}+0.178(b_{50})_{t-10}-0.755(b_{50})_{t-11}+v_t$

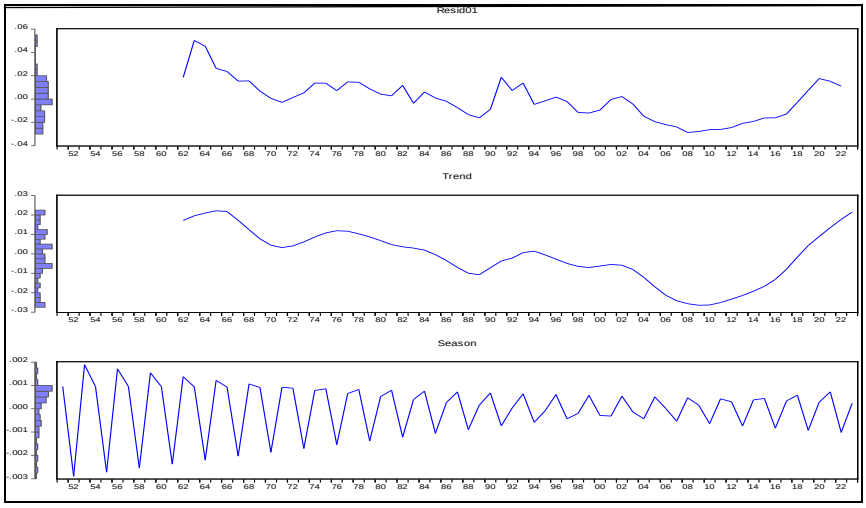
(0.065) (3.31)* (0.018) (0.271) (-1.527)

Where R^2=0.712,F=34706*,DW=0.26,SC=-5.01,AIC=-5.19,n=61,*=significant at 5% level.

For decomposition, Hamilton used STL method for v_t

$v_t = (b_{50})_t – [0.0017+1.529(b_{50})_{t-8}+0.0121(b_{50})_{t-9}+0.178(b_{50})_{t-10}-0.755(b_{50})_{t-11}]$

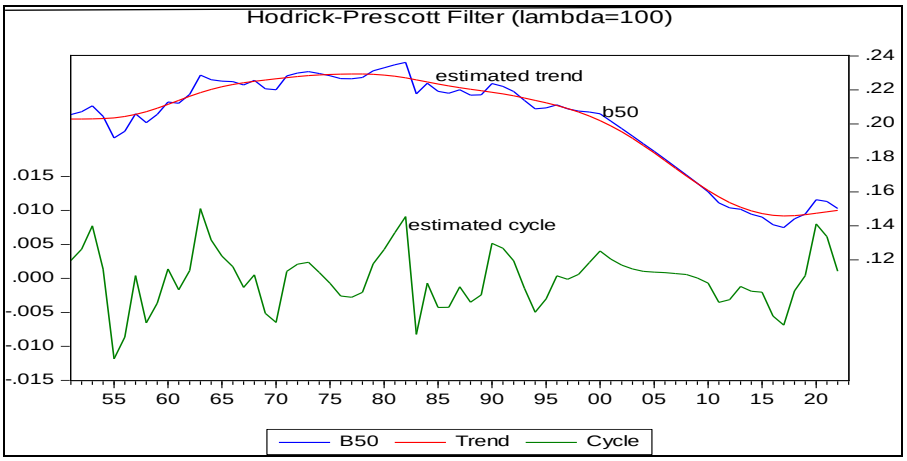
In Figure 25 panel 1, the residual v_t of regression equation has been plotted where it consists of 10 peaks and 9 troughs in the cyclical path of bottom 50% share in Indian national income from 1960 to 2022.While in the panel 2, the cyclical trend has been plotted in which 4 peaks and 4 troughs were seen as dominant patterns. As a whole the trend is downward followed by upward since 2009.In the third panel, the seasonal variations become v shaped and its vibrations shrink gradually.



Source: Plotted by Author

Figure 25: Decomposition of b_{50}

Under the Hodrick-Prescott Filter (1997) model the long run decomposition of bottom 50% income share showed inverse U shape in case of cyclical trend while its cyclical trend consists of 13 peaks and troughs. It is depicted in Figure 26.



Source: Plotted by Author

Figure 26: HP Filter of b_{50}

If GDP of India increases by 1% per year the income shares of bottom 50% will decrease by 0.1088% per year significantly during 1960-2022.The double log regression equation is given below.

$Log(b_{50})=1.269-0.1088log(gdp)$

(6.55)* (-14.92)*

Where R^2=0.785,F=222.783*,DW=0.085,SC=-2.16,AIC=-2.23,n=63,*=significant at 5% level,gdp=gross domestic product of India.

If per capita GDP of India grew by 1% per annum, then income share of bottom 50% declined by 0.149% per year significantly during 1960-2022.The double log regression equation is shown below.

$Log(b_{50})=-0.7292-0.1493log(gdppc)$

(-13.26)* (-16.38)*

Where R^2=0.814,F=268.462*,DW=0.1066,SC=-2.31,AIC=-2.38,n=63,*=significant at 5% level. gdppc=gross domestic product per capita

So that the changes in per capita GDP affected more negatively than the changes in GDP in the share of bottom 50% in India during 1960-2022.

India's national income share of top 10% has been growing at the rate of 0.634% per annum from 1951 to 2022 significantly. The trend equation is shown below.

$Log(h_{10})=-1.162+0.006349t+u_i$

(-38.57)*(9.42)*

Where R^2=0.559,DW=0.060,F=88.86*,SC=-1.18,AIC=-1.25,n=72,*=significant at 5% level.h_{10}= national income share of top 10%.

Hamilton (2018) regression filter equation is given below to show the non-linear trend pattern of top 10% national income share of India.

$(h_{10})_t=-0.028+1.583(h_{10})_{t-8}+0.131(h_{10})_{t-9}+0.016(h_{10})_{t-10}-0.604(h_{10})_{t-11}+v_t$

(-0.666) (3.40)* (0.201) (0.024) (-1.19)

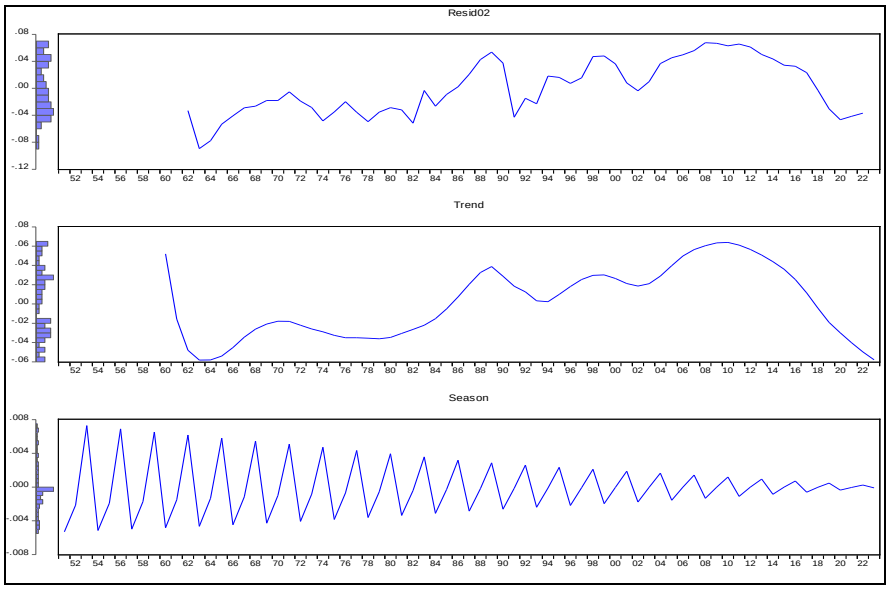
Where R^2=0.802,F=56.79*,DW=0.26,SC=-3.27,AIC=-3.44,n=61,*=significant at 5% level.

The residual of regression filter is decomposed into trend, seasonal fluctuation and cycles through STL method. It is given below.

$Vt=(h_{10})_t-[-0.028+1.583(h_{10})_{t-8}+0.131(h_{10})_{t-9}+0.016(h_{10})_{t-10}-0.604(h_{10})_{t-11}]$

In Figure 27, the panel 1 showed the decomposed v_t where its patterns consist of 10 peaks and 10 troughs in the path during 1960-2022.The cyclical trend in panel 2 consists of 4 peaks and 4 troughs where its ultimate pattern is upward followed by downward since 2010.

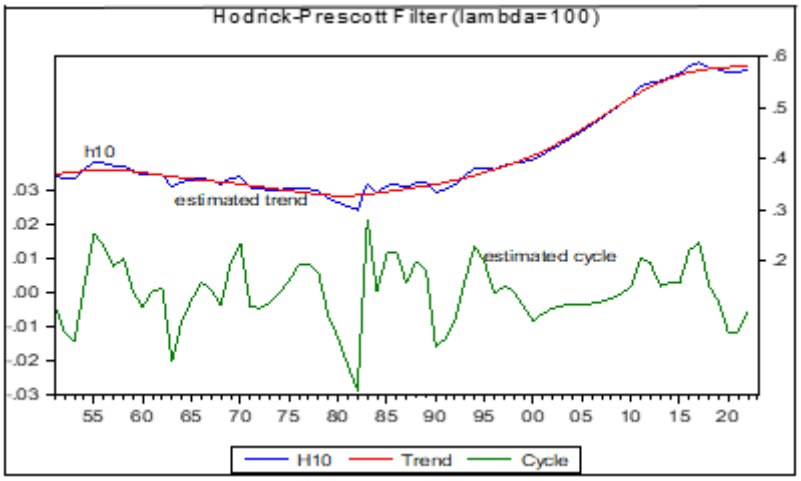
Panel 3 showed the v shaped seasonal fluctuations which tends to diminish throughout the period.



Source: Author's Own

Figure 27: Decomposition of Top 10%

On the other hand, the U-shaped cyclical trend curve of top 10% income share was observed from the Hodrick-Prescott Filter method during 1960-2022(Figure 28).



Source: Author's Own

Figure 28: HP Filter Model of Top 10% Income Share

If one percent increase in GDP per year in India, the income shares of top 10% increases by 0.128% per year significantly from 1960 to 2022.The double log regression equation is shown below.

$Log(h_{10})$=-4.324+0.128856log(gdp)

(-16.81)* (13.29)*

Where R^2=0.743,F=176.874*,DW=0.1036,SC=-1.60,AIC=-1.668,n=63,*=significant at 5% level.

Similarly, one percent hike in per capita gross domestic product of India per year leads to 0.176 percent increase in national income share of top 10% per year significantly from 1960 to 2022.The double log regression is given below.

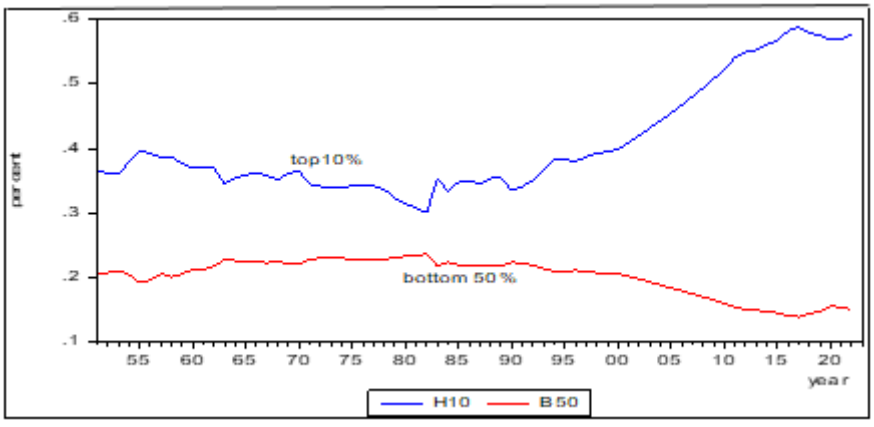
$Log(h_{10})$=-1.9568+0.17625log(gdppc)

(-26.11)*(14.18)*

Where R^2=0.767, F=201.23*, DW=0.122, SC=-1.698, AIC=-1.766, n=63,*=significant at 5% level.

Therefore, the increment in GDP per capita has influenced more to increase the top10% income share than the GDP changes in India during 1960-2022.

In Figure 29, both the income shares of bottom 50% and top10% in India from 1951 to 2022 have been depicted where top10% is U shaped and bottom 50% is inverse U shaped. From 1951 to 1982 the gap between the two comes closer and then the gap started to widen gradually.



Source: Author's Own

Figure 29: The Income Share Gap between Top 10% and Bottom 50%

The national income shares of the gap between top10% and bottom 50% in India from 1951 to 2022 has been catapulting at the rate of 1.55% per year significantly which is verified by the following trend equation.

$Log(h_{10}-b_{50})=-2.312+0.015578t$

(-27.15)*(8.18)*

Where R^2=0.489, F=67.02, DW=0.119, SC=0.88, AIC=0.82, n=72,*=significant at 5%,$h_{10}-b_{50}$= income share difference between top10% and bottom 50%.

The Hamilton regression filter equation of the gap between income shares of top 10% and bottom 50% given is below.

$G_t=0.0019+1.5244G_{t-8}+0.079G_{t-9}-0.0672G_{t-10}-0.423G_{t-11}+v_t$

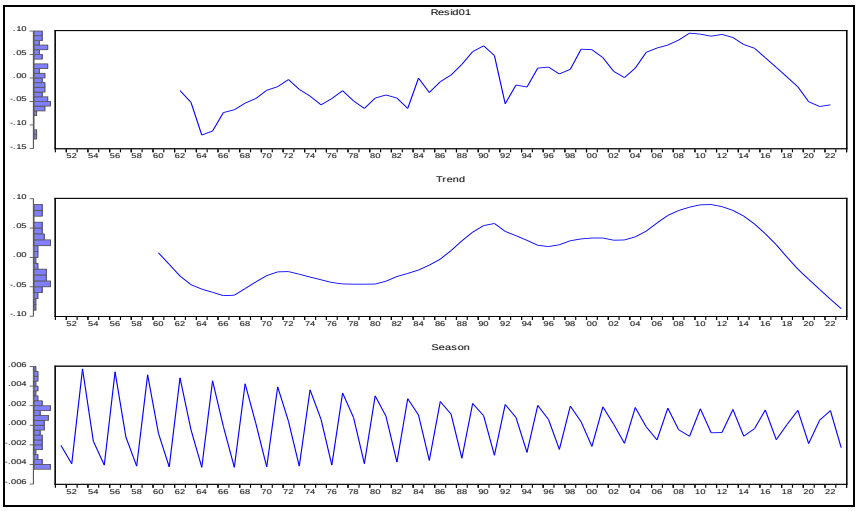
(0.082) (3.24)* (0.119) (-0.105) (-0.895)

Where R^2=0.768, F=46.35*, DW=0.2317, SC=-2.65, AIC=-2.83, n=61, *=significant at 5%,G= gap of income share between top10% and bottom50%.

Thus, the v_t is the residual of Hamilton regression filter model which is decomposed through STL method for trends, cycles and seasonal variation.

$V_t=G_t-[0.0019+1.5244G_{t-8}+0.079G_{t-9}-0.0672G_{t-10}-0.423G_{t-11}]$

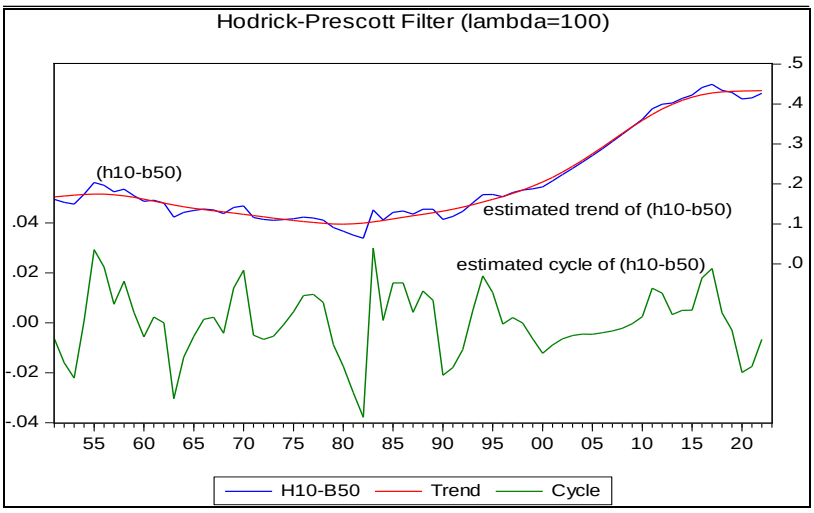
In Figure 30, the panel one implies the cyclical patterns which consists of 10 peaks and 10 troughs while cyclical trend consists of 4 peaks and 4 troughs in panel 2 and inverse v shaped seasonal variation was observed in panel 3 respectively.



Source: Author's Own

Figure 30: Decomposition of GAP Trend

The cyclical trend of the gap of income shares between top10% and bottom 50% during 1960-2022 has been shown as u shaped according to Hodrick-Prescott Filter model.



Source: Author's Own

Figure 3: HP Filter of ($h_{10} - b_{50}$)

If one percent increase in gross domestic product of India per annum, then the gap of income share leads to increase by 0.33% per year significantly during 1960-2022 which is shown below.

$Log(h_{10}-b_{50})=-10.528+0.3328log(gdp)$

(-14.67)* (12.31)*

Where R^2=0.713,F=151.6147*,DW=0.207,SC=0.451,AIC=0.383,n=63,*=significant at 5% level.

Similarly, one percent increase in per capita GDP per year in India leads to 0.452% increase in the gap of income share between top10% and bottom50% per year during 1960-2022 which is significant. It is shown below.

$Log(h_{10}-b_{50})=-4.392+0.4522log(gdppc)$

(-20.48)*(12.71)*

Where R^2=0.726,F=161.77*,DW=0.225,SC=0.404,AIC=0.336,n=63,*=significant at 5% level.

The cyclical trend of the gap of income shares between top10% and bottom 50% during 1960-2022 has been shown as u shaped according to Hodrick-Prescott Filter model.

Thus, the gap widens more in case of GDP per capita changes than the GDP changes in India during 1960-2022.

The residual of the gap of Hamilton regression filter model has been automatically passing through the ARIMA model which produces (2,1,2) process of ARMA structure that is shown by a regression equation which was done by ARMA Maximum Likelihood (OPG-BHHH) function during 1963-2022 in India.

$d(v_t)=-0.000378+0.4014v_{t-1}-0.938v_{t-2}-0.2804\varepsilon_{t-1}+0.998\varepsilon_{t-2}+0.00056\sigma^2_t$

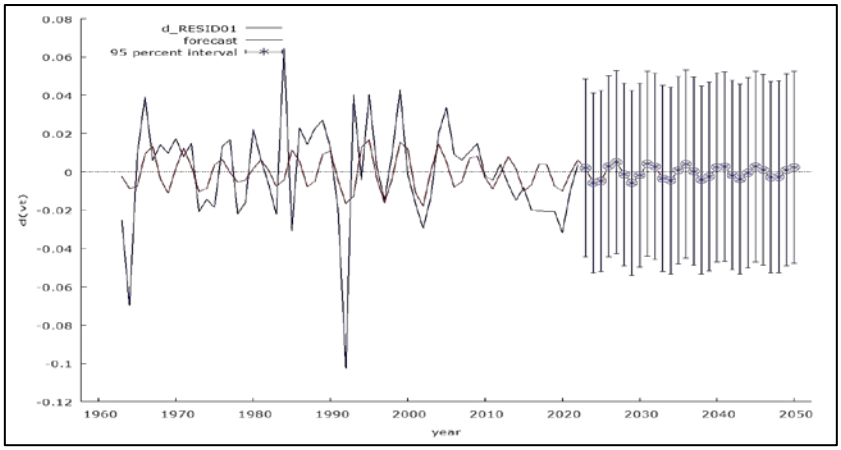
(-0.087) (2.89)* (-9.33)* (0.79) (0.90) (0.90)

Where R^2=0.1803, F=2.37*,SC=-4.17,AIC=-4.37(min),n=60,AR roots=0.20±0.95i,MA roots=0.14±0.99i,v_t= residual of the Hamilton regression filter model of the gap between top 10% and bottom 50%, σ^2_t =volatility ,AR(1)=v_{t-1},AR(2)=v_{t-2},MA(1)= ε_{t-1} ,MA(2)= ε_{t-2} *=significant at 5% level, d=first derivative

The ARIMA model (2,1,2) is highly feasible because AIC is minimum and coefficient of σ^2_t is minimum(i.e., volatility is minimum) . The roots of AR and MA are less than one. The model is stable but it is nonstationary because t values of coefficients of MA are insignificant yet the values of AR and MA coefficients are less than one. So that, it is stable and convergent. But due to insignificant t value of

coefficients of MA, the ARMA process departed away from equilibrium (which implies that the gap has been narrowing) and becomes nonstationary.

The forecast model of ARIMA (2,1,2) of the Hamilton regression filter residual (v_t) of the gap for 2050 has been converging towards equilibrium but ultimately it departed away from equilibrium which means the gap of inequality is narrowing in a non-stationary way. At 2022, the predicted value is 0.006224 which tends to the converging predicted value to 0.002343 in 2050 which is seen in the dotted red line between the blue crosses which are belonging to the level of significance at 5% (Figure 32).



Source: Author's Own

Figure 32: Forecast of GAP

Discussion

The following are the short term and long-term policy issues that India may consider to combat income inequality but when and in what conditions the policies are useful must be carefully verified subject to several constraints.

Chancel and Piketty (2017) suggested to improve education status which could promote quality of opportunity and can expand inequality dampening economic growth. Lawson and Martin (2018) insisted to introduce wealth tax and other progressive direct taxes and to enhance health and education expenditures to improve inequality. Yadav and Yadav (2023) recommended to implement progressive tax, increase health and education expenditures, inclusion of all stake holders in decision making process, and collective bargaining minimum wage respectively.

According to European commission (2021), India should fulfil SDGs 1,5,8,15 and 16 respectively in narrowing inequality of income. In case of macro policy, India should emphasise land reform and human capital development, increase efficiency of public good distribution and labour market reform. India's key principles must lie on [1] beneficiary approach [2] transparency and accountability [3] targeting the bottom 40%, and [4] consider territorial dimensions.

To improve the bottom 40% income share, India should promote education and health for all in remote areas, provide social protection policies in food and climate risk to vulnerable, sponsor the creation of decent employment with high labour standards, prioritising low-skill labour, establish access to infrastructures, services and means of political participation for marginalised communities, and support fair and progressive tax reforms for bottom 40%.

Monitoring is needed to evaluate people's views on the functioning and effectiveness of redistribution policies as a key role in narrowing inequality especially taxing to top 10% or top 20% as well as preferences of selection of policies and perception of policies (OECD, 2021).

John (2020) prescribed that imposition of labour protection laws on minimum wage, collective bargaining and social safety nets will protect workers from unprecedented shocks.

Polacko (2021) cautioned that in the neoliberal era, the policy makers should enact appropriate measures of restoring higher protection of labour from declining trend of labour wage share where government can promote and support for a new corporate governance model which will be liberal to settle feasible bargaining of wage and other social securities.

Bharti *et al*. (2024) recommended that broad based public investments in health, education and nutrition are required with imposing of super tax of 2% on the net wealth of the 167 wealthiest families in 2022-23 that would yield 0.5% of national income in revenue in fiscal space to combat inequality.

Limitations

In the econometric analysis, tests for autocorrelation, heteroscedasticity, and stability were not conducted to avoid additional complications. It may be more appropriate to assess the reliability of the ARIMA (2,1,2) forecast model for future accuracy. Additionally, using quarterly data could provide more robust results and improve predictions in future cycles, moving towards equilibrium.

Conclusion

The paper examines significant research on income inequality in India, revealing that the national income share of the top 1% declined from 1950 until the 1980s, followed by a steady rise until 2022. Similar patterns were observed for the top 0.1% and 0.01%. The income share of the middle 40% and the bottom 50% increased until the 1980s, after which both followed a U-shaped decline. Regarding wealth share, the bottom 50% experienced a steady decline from 12.29% in the 1960s to 6.12% between 2011 and 2020, while the top 10% saw a steady increase from 42.25% in 1971-1980 to 63.68% in 2011-2020. Additionally, there are disparities in income share among Scheduled Castes (SC), Scheduled Tribes (ST), Other Backward Classes (OBC), and Forward Castes (FC). High income inequality was also noted between rich and poor states in India.

The present paper examines income inequality in India from 1951 to 2022. It found that the share of the bottom 50% has been declining at a rate of 0.503% per year, following a cyclical pattern with four peaks and troughs, forming an inverse U shape. Meanwhile, the top 10% share has been increasing at a rate of 0.63% per year, also showing four peaks and troughs in cycles, but with a U shape. If GDP and GDP per capita increase by 1% per year, the share of the bottom 50% will decrease by 0.1088% and 0.1493% per year, respectively. Conversely, a 1% increase in GDP and GDP per capita per year will result in the share of the top 10% increasing by 0.128% and 0.176% per year, respectively. The gap between the top 10% and the bottom 50% narrowed until 1981, after which it began to widen, increasing at a significant rate of 1.55% per year. This gap follows a U-shaped pattern. A 1% increase in GDP and GDP per capita per year will cause the gap to widen by 0.33% and 0.45% per year, respectively. The automatically fitted ARIMA (2,1,2) model for 2050, derived from the residuals of the Hamilton regression filter, indicates convergence towards equilibrium in a stable manner. However, it is nonstationary because the moving average (MA) process is insignificant despite a significant autoregressive (AR) process, implying that inequality will not completely disappear by 2050.

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Conflict of interests

There is no conflict of interest in publishing this paper.

Declaration

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