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Asymmetry of Wealth and Income Inequality on GDP Growth Rate in India

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Abstract

Purpose: *The study examines to test asymmetry of income and wealth inequality on GDP growth rate in India during 1995-2023 through NARDL model.*

Methods: *The paper applied Shin et al. (2014) model to estimate asymmetry in NARDL model, applied Dicky and Fuller (1979) model for unit root test, applied Breusch-Pagan model (1979) to test the serial correlation and heteroscedasticity tests. Stability test was done by following Page (1954). Symmetry test was applied by using Wald test (1943). The data on income inequality and wealth inequality were collected from the World Inequality Data Lab and data on GDP growth rate were collected from the World Bank.*

Results: *The paper finds that positive and negative changes of cumulative dynamic multipliers of both income and wealth inequality impact on GDP growth favourably and adversely. Positive and negative responses diverge away from positive and negative long run limits and asymmetry lines of wealth and income inequality have no convergence. Cointegration of wealth and income inequality have negative impacts on GDP growth rate.*

Conclusion: *NARDL model can help policy makers to conduct fiscal and monetary policy and other welfare measures in both short run and long run to ameliorate inequalities towards sustainable GDP growth rate. The model can justify how positive and negative responses of asymmetries in short and long run affect GDP growth.*

Keywords: Income inequality, Wealth inequality, GDP growth rate, Asymmetry, NARDL model

I. Introduction

The lucid interpretation is that the concentration of wealth results in increasing division between the poor or middle classes and the wealthy investment classes and makes hazards of redistribution while income inequality led to hamper growth, healthcare, education, and creates political inequality too (Birdsong, 2015).The early studies of Alesina and Rodrik (1994), Persson and Tabellini (1994) and Perotti (1996) verified that income inequalities have negative impacts on economic growth while Braun et al. (2019), Breunig and Majeed (2020), Panizza (2002) and many others showed that the relation is positive. The structural wealth

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inequality in Italy had negative impact on growth rate during 1951 to 2001 as examined by Lasheras and Pellegrino (2024).

From the World Inequality Data Lab, it can be estimated that in India, the share of income of the top 10% had increased at the rate of 1.536% per year during 1995 to 2023 while share of bottom 50% had declined by -1.07% per year, so that income inequality rose at the rate of 3.48% per year during the above period. Moreover, the share of wealth of top 10% had catapulted by 0.833% per annum and the share of bottom 50% had dwindled by -1.66% per year during 1995-2023, so that wealth inequality had increased at the rate of 1.136% per annum significantly. On the other hand, the GDP growth rate of India decreased by -4.13% per year during the same period of 1995-2023.It indicates clearly that income and wealth inequality in India had inverse impact on the GDP growth rate. By applying Non-linear Auto Regressive Distributed Lag (NARDL) model, it was justified that how the positive and negative changes of income and wealth inequality had direct or adverse impact on the GDP growth rate in India where the dynamic nature of asymmetry was narrated through non-linear cumulative dynamic multiplier process over the period and found that there is no convergence in both short and long run although cointegration exists. The similar nature of asymmetry was observed in some of the advanced and developing economies in the world.

Market interactions and government policies have failed to ameliorate income and wealth inequalities simultaneously where ineffectiveness of social, political and uncertain determinants control major outcomes and private and public investment are not considered as pro-poor led growth strategy other than the macro-economic factors. Social sector investment and other potential welfare schemes can benefit to dwindle inequality. After all, handling inequality is a liability of government that should adopt monetary and fiscal policy to lower inequality (Visco, 2023).

II. Reviews

Using GMM regression model on 97 countries during 1995 to 2021, it was found that both lagged wealth Gini and current period income Gini have positive statistically significant coefficients. The lagged value of wealth Gini is a positive statistically significant coefficient where its magnitude is large. The financial inclusion is negative but not statistically significant. Combining the lagged value of wealth Gini, the income Gini and financial inclusion, it can be stated that lagged wealth Gini and the current income Gini have positive impacts which is statistically significant. Thus, the lagged wealth and savings rates have induced to increase wealth inequality globally as well as in the developed and developing countries. Income inequality is an important determinants of extreme wealth inequality or concentration while in the developed countries the savings rate matters. It is evident that reducing income inequality will go a long way towards dampening wealth inequality (Osakwe & Solleder, 2023).

In applying NARDL model in USA during 1917 to 2012 to examine the short and long-run (increase and decrease) asymmetric effects of income inequality on real output levels, Nasr et al. (2020) found that the long-run coefficients of positive changes have positive signs while the signs of those of negative changes were negative, indicating that a decrease or an increase in income inequality improved the real output levels in the USA. The model showed both short run and long run asymmetry where the long-run adjustment path displays a stronger reaction of the real output levels to a unitary increase or decrease in income distribution. The cumulative dynamic multipliers of income inequality responses are significantly positive or negative shocks in both short and long run on real output in USA.

Aye et al. (2020) studied in UK on Dynamic and Asymmetric Response of Inequality to Income Volatility from 1975Q1 to 2016Q1, by applying GARCH-M and structural VAR and found a positive effect of income volatility on inequality as well as form of inequality are affected by the growth volatility and there are asymmetric responses of inequality to income volatility. Impulse response functions imply that positive income shocks increase inequality to shift Gini inequality upward while negative shocks decrease inequality shifting Gini downward. The positive and negative shocks tend to be asymmetric when positive shocks have larger effects.

Thus, stabilization policy is to be effective to redistribute income to reduce asymmetry.

The study of the long-run relationship between wealth inequality and growth using a VAR estimation during 1970 to 2014 in France and USA showed that wealth inequality had negative impact on GDP growth rate and GDP per capita growth rate significantly which have cumulative effects on subsequent years. In both countries, an increase in wealth inequality causes a statistically significant decrease in growth of GDP per capita in subsequent years. Then any decrease in wealth inequality will subsequently increase growth rate. In France, if wealth of top 10% increase by 1%, then GDP per capita growth rate will decrease by 1.5% and its cumulative effect is 8%.The positive and negative changes in wealth inequality in France have no impact on negative association with GDP growth rate which implies that the increase of wealth for the richest people would decrease growth more than an equal decrease that would have the opposite effect (Policardo et al., 2024).

In Turkey, during 1980 to 2015, the NARDL model interpreted that one percent increase in positive shock in income inequality led to 0.045% increase in economic growth in the long run, while negative shock was insignificant. In the short run, positive shock in income inequality led to positive impact on economic growth while negative shock had no significant impact (Sungur & Altıner, 2020).

Fixed effect panel regression model during1970 to 2015 for China, France, Russia, U.K., and the U.S. with 167 observations revealed that wealth inequality shows a negative relationship with growth, while income inequality shows a positive relation which are significant. Sensitivity analysis taking control variables in income inequality and wealth inequality proved the significant observed results (Englund & Sjölund, 2018).

By applying PMG/panel ARDL estimators in 10 Asian and African developing economies, from 1990–2020, it was observed that there are long and short term negative and positive correlations between GDP per capita and income inequality where the GDP per capita coefficient is -0.003 over the long-term, and 0.001 over the short-term which are significant at 5% level. There is a two-way causality between GDP per capita and income inequality (Khan & Khan, 2023).

Taking WID data for 170 countries during the period 1995-2020, it was found that the correlation between wealth inequality and economic growth is negative which is significant for both top 1% and top 10% shares. This finding also represents that a one Standard Deviation increase in the share of top 1% is associated with a 0.39 percentage point decrease in growth rates. Through the GMM model for 165 countries during 1995-2019, it was found that wealth inequality is negatively associated with economic growth where a one standard deviation rise in wealth inequality led to 0.4 percentage point decrease in growth rate (Steenbrink & Skali, 2024).

The study of Khanday and Tarique (2023) explored that there are asymmetric effects of financial development to income inequality in India during 1980-2019 where negative shock reduced income inequality and positive shocks increase income inequality. The cumulative dynamic multipliers have shown asymmetric impacts.

Ngepah (2024) examined asymmetric response of poverty to growth and inequality in South Africa during 1993-2020 by quantile regression method and found that if positive growth rate is increased by 1%, then the probability of being poor will decline by 0.14, poverty gap by 0.17 and the square of poverty gap by 0.1 respectively. It has significant positive impacts on incomes of both top 20% and bottom 50% but the impact is weaker on the bottom 40%. On the other hand, if negative growth rate increased by 1% then probability of being poor increased by 0.02, poverty gap by 0.011 and the square of poverty gap by 0.003 respectively. This effect induced to reduce 0.28% in top 20% income in comparison to 0.62% for bottom 40%. It implies that the poor bear a greater burden of negative economic shocks than the rich, but positive growth rates benefit the rich more. If inequality growth increases by 1% then incomes of 20th,40th,60th and 80th percentile will decrease by 0.25%,0.21%,0.17% and

0.10% respectively.

The other related study of Taghizadeh-Hesary et al. (2020) found that quantitative & qualitative easing monetary and tax policies decreased income inequality in Japan during 2002Q1–2017Q3.The research of Mumtaz and Theophilopoulou (2017) found that contractionary monetary policy raised income inequality in the UK during 1969 to 2012.

The paper tries to examine the asymmetry of wealth and income inequality on the impact of GDP growth rate in India from 1995 to 2023 because the positive and negative changes of wealth inequality and income inequality have cumulative dynamic multiplier effects on the GDP growth rate in both short run and long run. These asymmetries have adverse and positive impacts in non-linear relationships between them. It is clearly explained in this paper by applying NARDL model.

III. Methodology

The NARDL asymmetry model of income inequality and wealth equality in India from 1995 to 2023 was examined by following Shin et al. (2014) model which is shown below in brief.

$$y_t = \sum_{j=0}^{p} \emptyset_j y_{t-j} + \sum_{j=0}^{q} (\left(\theta_j^{+*} x_{t-j}^{+} + \theta_j^{-*} x_{t-j}^{-} \right) + \varepsilon_t$$

Where x_t is a kx1 vector of multiple regressor defined such that $x_t = x_0 + x_t^+ + x_t^-$, θ_j is the autoregressive parameter, θ_i^+ *and* θ_j^- are asymmetric distributed parameters, and ε_t is an i,i,d, process with zero mean and constant variance σ^2.

x_t is decomposed into x_t^+ and x_t^- around a threshold of zero, thereby distributing between + and – changes in the rate of growth of x_t.

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max(\Delta x_j , 0)$$

$$x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} \min(\Delta x_j , 0)$$

The error correction form is given below:

$$\Delta y_t = \rho y_{t-1} + \theta^{+*} x_{t-1}^+ + \theta^{-*} x_{t-1}^- + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} \varphi_j^{+*} \Delta x_{t-j}^+ + \sum_{j=0}^{q-1} \varphi_j^{-*} \Delta x_{t-j}^- + \varepsilon_t$$

$$= \rho y_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{p-1} (\varphi_j^{+*} \Delta x_{t-j}^+ + \varphi_j^{-*} \Delta x_{t-j}^-) + \varepsilon_t$$

Where $\rho = \sum_{j=1}^{p} \emptyset_j - 1; \gamma_j = -\sum_{i=j+1}^{p} \emptyset_i \quad for\ j = 1,2 \ldots \ldots p\ \ and\ \theta^+ = \sum_{j=0}^{q} \theta_j^+$

$$\theta^- = \sum_{j=1}^{q} \theta_j^- ;\ \varphi_0^+ = \theta_0^+ \varphi_j^+ = -\sum_{t=j+1}^{q} \theta_j^+ \quad for\ j = 1,2, \ldots\ldots q-1$$

$$\varphi_0^- = \varphi_j^- = -\sum_{i=j+1}^{q} \theta_j^- \quad for\ all\ j = 1,2,3, \ldots\ldots\ldots\ldots\ldots\ldots\ldots p-1$$

Therefore, ECM can be written as:

$$\Delta y_t = \rho\epsilon_{t-1} + \sum_{j=1}^{p=1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} (\pi_j^{+*}\Delta x_{t-j}^{+} + \pi_j^{-*}\Delta x_{t-j}^{-})$$

Where $\pi_0 = \theta_0^+ + \omega; \pi_0^- = \theta_0^- + \omega; \pi_j^+ = \varphi_j^+ - \omega\forall_j$ and $\pi_j^- = \varphi_j^- - \omega\forall_j$ for $j = 1,2,\ldots\ldots q-1$

Error correction term can be written as:

$$ECT_{t-1} = y_t - \alpha_1^+ x_t^+ - \alpha_2^- x_t^-$$

Now, the cumulative dynamic multiplier can be interpreted as :

$$m_h^+ = \sum_{j=0}^{n} \frac{\partial y_{t+j}}{\partial x_t^+} = \sum_{j=0}^{h} \mu_j^+ ; m_h^- = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{\partial x_t^-} = \sum_{j=0}^{h} \mu_j^- \quad where\ h = 0,1,2 \ldots\ldots$$

$as\ h \rightarrow \propto, m_h^+ \rightarrow \beta^+\ and\ m_h^- \rightarrow \beta^-\ where\ \beta^+ = -\frac{\theta^+}{\rho}\ and\ \beta^- = -\frac{\theta^-}{\rho}$

are long run asymmetric coefficients.

$$\Delta y_t = \rho y_{t-1} + \theta^{+*} x_{t-1}^{+} + \theta^{-*} x_{t-1}^{-} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{q-1} \varphi_j^{+*} \Delta x_{t-j}^{+} + \sum_{j=0}^{q-1} \varphi_j^{-*} \Delta x_{t-j}^{-} + \varepsilon_t$$

$$= \rho y_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{p-1} (\varphi_j^{+*} \Delta x_{t-j}^{+} + \varphi_j^{-*} \Delta x_{t-j}^{-}) + \varepsilon_t$$

Where $\rho = \sum_{j=1}^{p} \emptyset_j - 1; \gamma_j = -\sum_{i=j+1}^{p} \emptyset_i$ for $j = 1,2 \ldots\ldots p$ and $\theta^+ = \sum_{j=0}^{q} \theta_j^+$

$$\theta^- = \sum_{j=1}^{q} \theta_j^- ;\ \varphi_0^+ = \theta_0^+ \varphi_j^+ = -\sum_{t=j+1}^{q} \theta_j^+ \quad for\ j = 1,2, \ldots\ldots q-1$$

$$\varphi_0^- = \varphi_j^- = -\sum_{i=j+1}^{q} \theta_j^- \quad for\ all\ j = 1,2,3, \ldots\ldots\ldots\ldots\ldots\ldots\ldots p-1$$

$\varphi_t = y_t - \beta^+ x_t^+ - \beta^- x_t^-$ $is\ non\ linear\ error\ correction\ term\ where\ \beta^+ = -\frac{\theta^+}{\rho}\ and\ \beta^- = -\frac{\theta^-}{\rho}$ are associated with long run parameters.

The unit root test has been conducted by using Dicky and Fuller (1979) model. The serial correlation and heteroscedasticity tests were done by applying Breusch-Pagan model (1979). Stability test was done by following Page (1954). Symmetry test was applied by using Wald test (1943).

Income inequality(y) was calculated by using (h_{10}-b_{50}) and wealth inequality(w) was calculated by using (w_{10}-w_{50}).

The data on wealth share of top 10% (w_{10}) and bottom 50% (W_{50}) and data on income share of top 10%(h_{10}) and bottom 50% (b_{50}) from 1995 to 2023 for India were collected from World Inequality Data Lab. The data on GDP growth rate(x) of India from 1995 to 2023 were collected from the World Bank.

IV. Results and Discussion

Unit Root Test

The Dicky-Fuller unit root test (1979) revealed that the level series of GDP growth rate in India during 1995-2023 contains no unit root and is stationary because ADF=-5.038 (p=0.0003) which is greater than the tabulated ADF=-2.97 at 5% significant level. Similarly, the level series of income inequality has no unit root and is stationary because ADF=-3.952 (p=0.0064) which is greater than the tabulated value at 5% significant level. But, the level series of wealth inequality contains unit root and is non-stationary because ADF=-0.415(p=0.893) which is less than the tabulated value at 5% significant level while the first difference series of wealth inequality has no unit root and is stationary because ADF=-4.259(p=0.0026) which is greater than the tabulated ADF at 5% level. Therefore, NARDL model can be conducted without any barriers.

Asymmetry of wealth inequality

Table 1

Estimated NARDL Wealth Inequality

Variable	Coefficient	Standard Error	t-Statistic	Probability
Dependent=$d(x)_t$		Long run		
$d(x)_{t-1}$	-4.063022	0.513602	-7.910838*	0.0014
$d(y)_{t-1}$	217.2719	101.9377	2.131418**	0.1000
		Asymmetric		
$cdm(dw)^+_{t-1}$	-322.4280	134.5609	-2.396149*	0.0747
$cdm(dw)^-_{t-1}$	-344.6109	137.7420	-2.501857**	0.0666
c	-3.370827	1.303754	-2.585478**	0.0610
		Short run		
$d(x)_{t-1}$	2.426390	0.426283	5.691972*	0.0047
$d(x)_{t-2}$	1.677958	0.302352	5.549688*	0.0052
$d(x)_{t-3}$	0.907902	0.163778	5.543505*	0.0052
$d(y)_t$	235.5219	43.54854	5.408262*	0.0057
$d(y)_{t-1}$	-53.18649	51.92169	-1.024360*	0.3636
$d(y)_{t-2}$	262.8011	45.05019	5.833518*	0.0043
$cdm(dw)^+_t$	177.6741	43.91892	4.045502*	0.0155
$cdm(dw)^-_t$	-213.3728	64.85901	-3.289795*	0.0302
$cdm(dw)^+_{t-1}$	-14.26911	127.2703	-0.112117	0.9161
$cdm(dw)^-_{t-1}$	495.6817	106.7095	4.645149*	0.0097
$cdm(dw)^+_{t-2}$	64.01841	107.2799	0.596742	0.5828
$cdm(dw)^-_{t-2}$	-36.41737	57.09571	-0.637830	0.5583
$cdm(dw)^+_{t-3}$	300.9408	78.61806	3.827884*	0.0187
$cdm(dw)^-_{t-3}$	-101.2765	43.64132	-2.320657*	0.0811

R^2=0.997, F=79.14, loglikelihood=-11.08, AIC=2.616, SC=3.554, n=23, ARDL(4,3,4),2001-2023 DW=2.908, *=significant at 5% level, **=significant at 10% level, d=increment or first difference, cdm=cumulative dynamic multiplier.*

Note. Calculated by author

The estimated NARDL(4,3,4) model of asymmetric shock of wealth inequality on economic growth in India during 1995 to 2023 (after adjustment, the period is 2000 to 2023) stated that increment in GDP growth rate is negatively associated with its previous year significantly and related positively with income inequality of previous year significantly in the long run while both positive and negative changes of incremental cumulative dynamic multipliers of wealth inequality are negatively related with increment in GDP growth rate insignificantly at lag 1.On the other hand, increment of GDP growth rate is positively associated with all previous periods significantly and positively related with increments of income inequality at level and lag 2 significantly in the short run. The positive changes of increments of cumulative dynamic multipliers of wealth inequality at level, and lag 3 are positively related with increment of GDP growth rate significantly while negative changes at level, lag 1 and lag 3 have negative impacts significantly in the short run. The model is a good fit with high R^2 and significant F and DW with minimum AIC (Table 1).

The Bounds test reveals that F=9.149 and t statistic =-7.91 which are greater than the critical values of I(0) and I(1) at 10%,5% and 1% levels of significance respectively which are tabulated below. It implies that there is no problem to run NARDL model and there is existence of cointegration (Table 2).

Table 2

Bounds Test

F statistic	Sample Size	Sig. level10%	Significant level 5%	Significant level 1%
Order				
I(0)	30	3.008	3.710	5.333
I(1)	30	4.150	5.018	7.063
I(0)	Asymptotic	2.720	3.230	4.290
I(1)	Asymptotic	3.770	4.350	5.610
t-statistic				
I(0)	Asymptotic	-2.570	-2.860	-3.430
I(1)	Asymptotic	-3.460	-3.780	-4.370

Note. Calculated by author

The symmetry test of the estimated NARDL on wealth inequality stated that in the long run as well as in the short run, t-statistic, F-statistic and Chi-square statistic are accepted at null hypothesis H0=coefficient is symmetric (Table 3).

Table 3

Symmetry Test

Variable	Statistic	Degree offreedom	Value	Probability
			Long run	
D(W)	t-statistic	4	1.742614	0.1564
	F-statistic	(1, 4)	3.036703	0.1564
	Chi-square	1	3.036703	0.0814
			Short run	
D(W)	t-statistic	4	1.947091	0.1234
	F-statistic	(1, 4)	3.791164	0.1234
	Chi-square	1	3.791164	0.0515

Note. Calculated by author

The residual test of estimated asymmetry of wealth inequality on GDP growth rate has no heteroscedasticity problem since F statistic, nR^2 statistic and scaled explained SS statistic are accepted at H0=homoscedasticity (Table 4).

Table 4

Heteroskedasticity Test: Breusch-Pagan-Godfrey

Statistic	value	Statistic and degree of freedom	probability
F-statistic	2.570352	Prob. F(18,4)	0.1863
nR^2	21.16975	Prob. Chi-Square (18)	0.2709
Scaled explained SS	0.778974	Prob. Chi-Square (18)	1.0000

Note. Calculated by author

The residual test of estimated asymmetry of wealth inequality on GDP growth rate has serial correlation problem since F statistic, nR^2 statistic are not accepted at H0=No serial correlation (Table 5).

Table 5

Breusch-Godfrey Serial Correlation LM Test (up to lag 2)

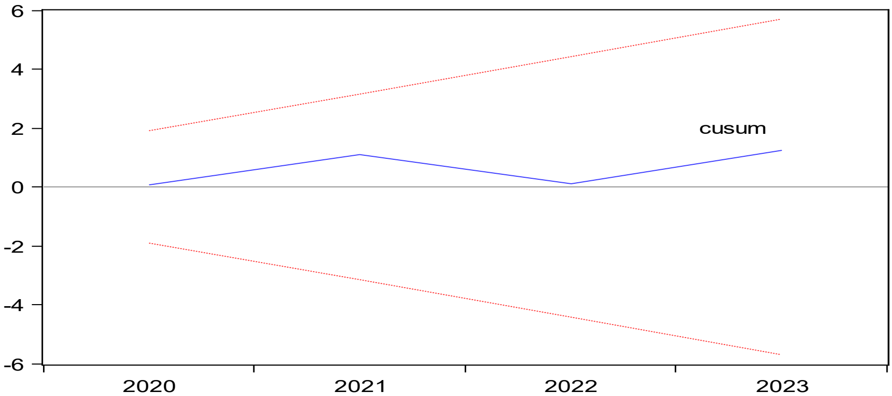
Statistic	Value	Statistic and degree of freedom	Probability
F-statistic	3.835307	Prob. F(2,2)	0.2068
nR^2	18.24332	Prob. Chi-Square (2)	0.0001

Note. Calculated by author

The residuals are normally distributed since Jarque-Bera=0.385 whose probability of acceptance is 80% (p=0.824).The asymmetry model is stable since the cumulative sum line passes through ±5% significant level which is depicted in Figure 1.

Figure 1

Stability Test of Wealth Equality



The cointegration equation states that the incremental income inequality at lag 1 is positively related with increment of GDP growth rate at level, when positive and negative changes of cumulative dynamic multiplier of incremental wealth inequality at lag 1 are negatively related with increment of GDP growth rate, all of which are significant when the cointegrating equation has been converging towards equilibrium at the speed of adjustment of 406% per annum significantly.

Estimated Cointegration equation is stated below:

$$z_{t-1}=-4.063d(x)_{t-1}+53.47d(y)_{t-1}-79.35cdm(dw)^{+}_{t-1}-84.81cdm(dw)^{-}_{t-1}$$

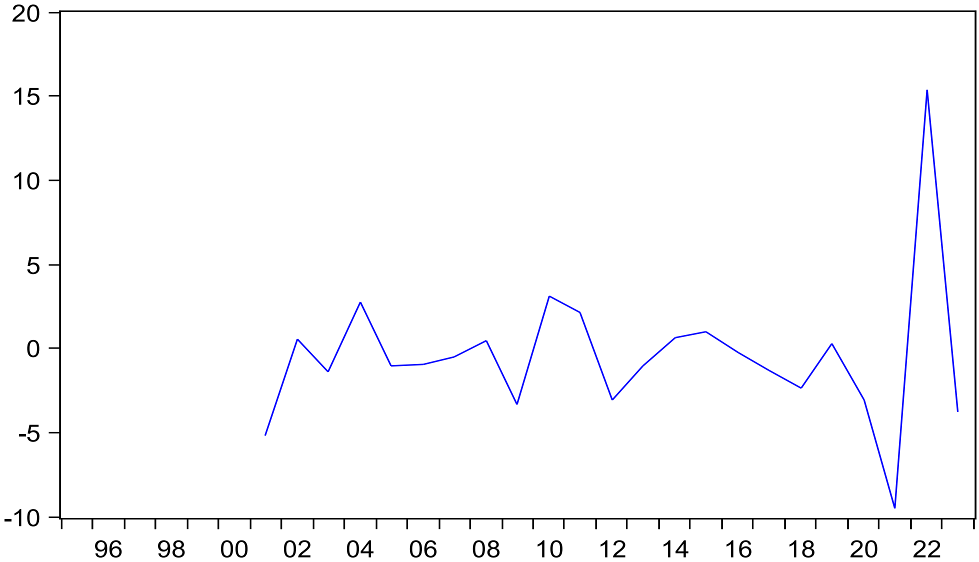
(-15.27) * (2.63)* (-2.60)* (-2.75)*

Where Z is a normalised variable, *=significant at 5% level, t values are in first brackets.

The cointegration equation is depicted below in Figure 2 where it is moving around zero and converges towards zero.

Figure 2

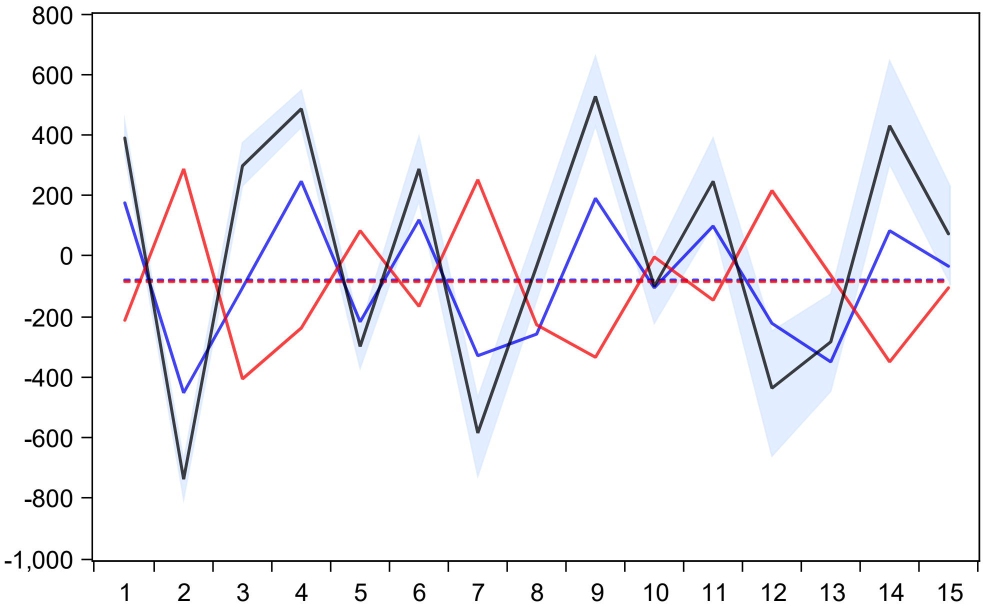
Cointegrating Equation



The positive changes of cumulative dynamic multiplier of incremental wealth inequality have varied from downward to upward movement producing positive and negative impacts but never converged to positive long run limit although magnitudes of variations decreased while the negative changes produced both positive and negative impacts with higher volatilities and did not converge to negative long run limit. Both of them are outside the confidence interval. The asymmetry of wealth inequality passes through confidence interval varying downward to upward impacts on increment of GDP growth rate with increasing volatility showing v shaped positive and negative changes of asymmetry up to 15 horizons. The asymmetry did not converge to zero (Figure 3).

Figure 3

Asymmetry of Wealth Inequality



Note. red line (=negative response), blue line (= positive response), and black line (=asymmetry)

The estimated NARDL (4,3,4) model of asymmetric shock of income inequality on incremental GDP growth rate in India during 1995-2023(after adjustment, the period becomes 2000-2023) stated that increment in GDP growth rate is negatively related with increment of GDP growth rate at lag 1 and wealth inequality at lag 1 significantly in the long run. The positive and negative changes of cumulative dynamic multiplier of incremental income inequality at lag 1 are directly related with increment of GDP growth rate significantly in the long run. On the other hand, in the short run, increment of GDP growth rate is positively related with its all three lags significantly, and negatively related with increment of wealth inequality at level and lag 1 and positively related at lag 2 significantly .The positive changes of cumulative dynamic multiplier of incremental income inequality is positively related with incremental GDP growth rate significantly while negative changes of incremental cumulative dynamic multiplier of change in wealth inequality at lag 1 are negative and significant while remaining are insignificant. The model is highly significant with minimum AIC, high R^2, high DW and significant F (Table 6).

Table 6

Estimated NARDL Asymmetry of Income Inequality

Variable	Coefficient	Standard Error	t-Statistic	Probability
Dependent = $d(x)_t$		Long run		
$d(x)_{t-1}$	-7.464255	1.494497	-4.994492*	0.0075
$d(w)_{t-1}$	-794.6858	218.7520	-3.632817*	0.0221
		Asymmetric		
$cdm(dy)^+_{t-1}$	1384.127	412.2473	3.357516*	0.0284
$cdm(dy)^-_{t-1}$	1214.794	347.8203	3.492593*	0.0251
c	-23.69972	7.903224	-2.998741*	0.0400
		Short run		
$d(x)_{t-1}$	5.099360	1.234221	4.131643*	0.0145
$d(x)_{t-2}$	3.435715	0.893065	3.847105*	0.0183
$d(x)_{t-3}$	1.154068	0.496009	2.326706**	0.0805
$d(w)_t$	-149.7352	64.16990	-2.333418**	0.0800
$d(w)_{t-1}$	293.3278	115.4795	2.540086**	0.0640
$d(w)_{t-2}$	173.8442	85.12133	2.042310	0.1107
		Asymmetric		
$d(cdm(dy)^+_t$	786.5995	245.1453	3.208707*	0.0326
$d(cdm(dy)^-_t$	292.3493	220.2000	1.327654	0.2550
$d(cdm(dy)^+_{t-1}$	-140.0494	205.6266	-0.681086	0.5332
$d(cdm(dy)^-_{t-1}$	-1037.986	330.1670	-3.143820*	0.0347
$d(cdm(dy)^+_{t-2}$	-602.9957	349.0016	-1.727773	0.1591
$d(cdm(dy)^-_{t-2}$	89.90747	232.8383	0.386137	0.7191
$d(cdm(dy)^+_{t-3}$	-602.3378	359.4104	-1.675905	0.1691
$d(cdm(dy)^-_{t-3}$	-179.8958	225.2365	-0.798697	0.4692

R^2=0.985, F=15.14*, loglikelihood=-29.97, AIC=4.25, SC=5.19, DW=1.71, n=23, ARDL(4,3,4), *=significant at 5%,**=significant at 10%, d=first difference, cdm=cumulative dynamic multiplier

Note. Calculated by Author

The Bounds test reveals that F=6.5688, and t statistic=-4.994 which are greater than the critical values of I(0) and I(1) at 10%, and 5% levels of significance respectively which are tabulated below. It implies that the model can be estimated without obstacles and there exists cointegration (Table 7).

Table 7

Bounds Test of Income Inequality

Order	Sample Size	Sig. level10%	Significant level 5%	Significant level 1%
			F statistic	
I(0)	30	3.008	3.710	5.333
I(1)	30	4.150	5.018	7.063
I(0)	Asymptotic	2.720	3.230	4.290
I(1)	Asymptotic	3.770	4.350	5.610
			t- statistic	
I(0)	Asymptotic	-2.570	-2.860	-3.430
I(1)	Asymptotic	-3.460	-3.780	-4.370

Note. Calculated by author

The symmetry test of the estimated NARDL on income inequality stated that in the long run and in the short run t-statistic, F-statistic and Chi-square statistic are accepted at null hypothesis H0=coefficient is symmetric (Table 8).

Table 8

Symmetry Test

Variable	Statistic	Degree of freedom	Value	Probability
		Long run		
D(y)	t-statistic	4	1.772882	0.1509
	F-statistic	(1, 4)	3.143109	0.1509
	Chi-square	1	3.143109	0.0762
		Short run		
D(y)	t-statistic	4	0.397804	0.7111
	F-statistic	(1, 4)	0.158248	0.7111
	Chi-square	1	0.158248	0.6908

Note. Calculated by author

The residual test of estimated asymmetry of income inequality on GDP growth rate has no heteroscedasticity problem since F statistic, nR^2 statistic and scaled explained SS statistics are accepted at H0=homoscedasticity (Table 9).

Table 9

Breusch-Pagan-Godfrey Heteroskedasticity Test

Statistic	Value	Degree of freedom and statistic	Probability
F-statistic	1.865149	Prob. F(18,4)	0.2890
nR^2	20.55141	Prob. Chi-Square (18)	0.3026
Scaled explained SS	0.373703	Prob. Chi-Square (18)	1.0000

Note. Calculated by Author

The residual test of estimated asymmetry of income inequality on GDP growth rate has serial correlation problem since nR^2 statistic are not accepted at H0=No serial correlation while F statistic is accepted for no serial correlation (Table 10).

Table 10

Breusch-Godfrey Serial Correlation LM Test (lag 2)

Statistic	Value	Degree of freedom and statistic	Probability
F-statistic	0.364422	Prob. F(2,2)	0.7329
nR^2	6.143043	Prob. Chi-Square(2)	0.0464

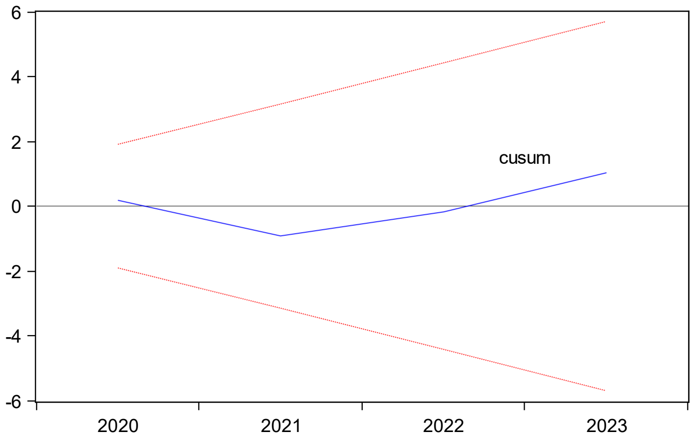
Note. Calculated by author

The residuals are normally distributed since Jarque-Bera=0.969(p=0.615) whose probability of acceptance is 61%.

The asymmetric model is stable since CUSUM line passes through ±5%significant level which is depicted in Figure 4.

Figure 4

Stability Test of Income Inequality



The cointegration equation is estimated below:

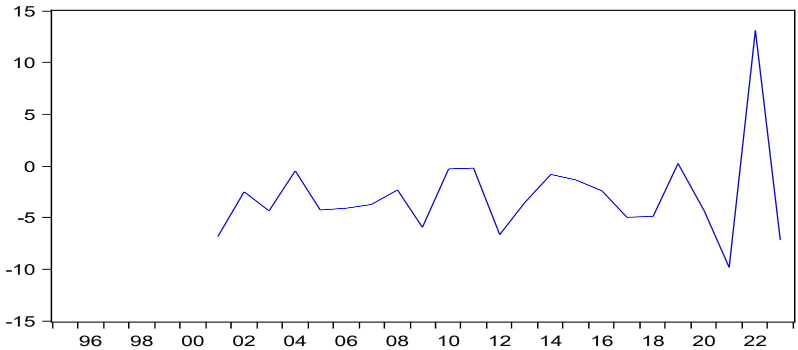
$$z_{t-1}=-7.46d(x)_{t-1}-106.46(\mathrm{dw})_{t-1}+185.43cdm(dy)^{+}_{t-1}+162.74cdm(dy)^{-}_{t-1}$$

(-6.78)* (-6.39)* (5.26)* (5.59)*

Where z is a normalised variable and t values are shown in the first brackets, *=significant at 5% level. The cointegrating equation implies that incremental wealth inequality at lag 1 is negatively related with increment of GDP growth rate at lag 1 and positive and negative changes of cumulative dynamic multipliers of incremental income inequality at lag 1 are positively related with increment of GDP growth rate at lag 1, all of which are significant at 5% level. The cointegrating equation has been converging towards equilibrium at the speed of adjustment of 746% per annum significantly during 2000 to 2023 in India. The cointegrating equation is shown below in Figure 5 where it is found that the equation is moving around zero.

Figure 5

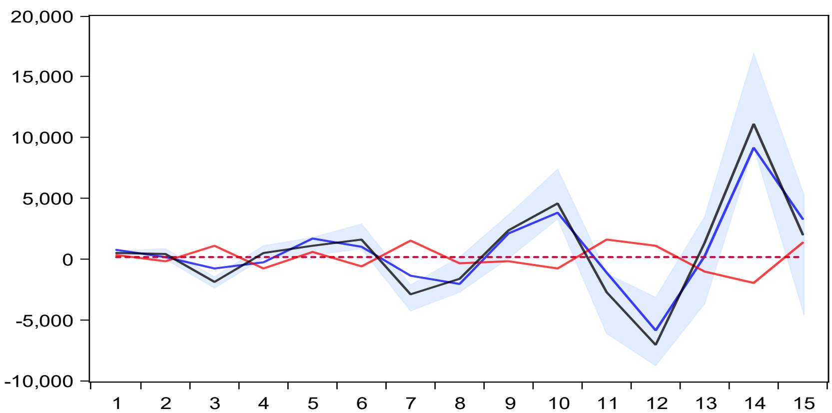
Cointegrating Equation



The positive changes of cumulative dynamic multiplier of incremental income inequality started downward near zero then slowly varies positive and negative directions around zero creating increasing volatility and did not converge to positive long run limit but passing through confidence interval while the negative changes have strong positive and negative impacts and did not converge to negative long run limit without staying in confidence interval. It is strongly volatile. The asymmetry of incremental income inequality passes through confidence interval varying positive to negative impacts on increment of GDP growth rate with showing rising volatility patterns up to 15 horizons while negative impacts dominated. The asymmetry had no chance to converge towards zero (Figure 6).

Figure 6

Asymmetry of Income Inequality



Note. red line (=negative response), blue line (= positive response), and black line (=asymmetry)

Discussion and Policy Issues

Inequality of wealth distribution is historical and turned to be skewed and its shocks create more inequality which need institutional measures (Bavel & Scheffer, 2021). Uncertainties and other natural disasters are crucial determinants of asymmetry of income and wealth inequalities. If disposable income is taken into account, then uncertainty shocks led to reduce income inequality since monetary policy do not have strong distributional consequences (Choi & Phi, 2024). Besides, policy errors, ignoring threshold limits and targets of macro-economic fundamentals in the short run as well as long run destabilize the economy which might prevent to minimize inequalities. It is necessary to find out the real economic and social causes of positive changes of income and wealth inequalities that have positive impacts on growth in India. Recent empirical evidence in US economy implied that asymmetry of income inequality and wealth inequality do not always insist to increase real income growth rate rather policy makers should use other welfare improvement measures to ameliorate inequality (Nasr et al., 2020).

Policies such as progressive taxation, social protection measures, higher investment in health and education, social sector investment, wealth tax differentials, income tax differentials, compulsory insurances for vulnerable peoples, equitable social justice, redistribution transmissions channels of income execution and monitoring, credit and banking facilities for the poor, data preservation for future policies are crucial for reducing wealth inequality and income inequality in India. Protection and disaster management in natural calamities for vulnerable sections are needed. Employment guarantee and skill development programs are corollary measures to ameliorate inequality. Sometimes, lower interest rate raises new capital for entrepreneurs which increase wealth inequality in different channels (Gomez & Gourin-Bonenfanty, 2020).

Limitations and Future Research

The paper contains some limitations such as the span of time period from 1995 to 2023 which was obtained from WID Lab. If the time period increases the outcome of observations might be more valuable, even if the model could take other related macro variables along with control variables, then the results might be better to highlight policy issues. So, there is enough scope for future research in this theme.

V. Conclusion and Implication

The paper concludes that India has been confronting with asymmetry of wealth inequality and income inequality during the specified period as envisaged from NARDL model which showed that positive and negative changes of cumulative dynamic multipliers of incremental wealth inequality have negative impact on incremental GDP growth rate significantly in the long run while positive changes have positive impacts and negative changes have negative impacts in the short run. The asymmetry has been diverging and did not merge towards zero in which both positive changes and negative changes of cumulative dynamic multipliers of wealth inequality on incremental GDP growth rate did not converge towards long run positive and negative limits. The model has no heteroscedasticity, serial correlation but exists non-normality problem. The estimated cointegrating equation implies that positive and negative changes of cumulative dynamic multiplier of incremental wealth inequality at lag one is negatively related with increment of GDP growth rate significantly and it is converging towards equilibrium significantly.

The incremental GDP growth rate is positively influenced by positive and negative changes of cumulative dynamic multiplier of incremental income inequality significantly in the long run while positive and negative changes of cumulative dynamic multiplier of incremental income inequality have positive and negative impacts on incremental GDP growth rate significantly in the short run. The asymmetry of income inequality is volatile and did not converge to zero when positive and negative changes of cumulative dynamic multiplier of incremental income inequality did not move towards positive long run limit and negative long run limit respectively. According to cointegrating equation, the positive and negative changes of cumulative dynamic multipliers of incremental income inequality at lag one is positively related with increment of GDP growth rate at lag one significantly. The cointegrating equation has been converging towards equilibrium with the high speed of adjustment significantly. This model is stable and follows normal distribution without serial correlation and heteroscedasticity.

This model can help the planners immensely to determine the short-term or long-term execution. The property of cumulative dynamic multiplier of the selected variable will guide the planners when and how to impose it to get feasible benefit and can forecast asymmetric behaviour and also formulate strategies of policy design. The imposition of wealth tax in short run asymmetry of wealth inequality on GDP growth rate might be beneficial while wealth ceiling, property tax, protection of wealth concentration might be helpful in the long run for sustainable growth. Progressive income tax in case of short run asymmetry in income inequality might be attractive while freezing income in case of long run asymmetry would be effective. Employment generating poverty alleviation programme, social security programme, social welfare improvement schemes, insurance protection for poor will be effective to reduce income inequality to boost GDP growth in both short and long run. The NARDL model can give clear indications to the government to execute such policies properly. Besides, the policy prescription on the negative response of income and wealth concentration is challenging to the government under SDGs.

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