Integral Research
(ISSN: 3048-5991) Coden: IRABCA

Research Article
(Peer-reviewed, Open Access & Indexed Multidisciplinary Journal)
Journal home page: https://integralresearch.in/
Vol. 03, No. 05, May. 2026

Nexus Among GDP Per Capita with Income Inequality, Wealth Inequality, Human Development Index and Unemployment Rate in India in Ardl Model

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The relation between India's GDP per capita, income inequality, wealth inequality, human development index and unemployment rate during 1990-2025 was analyzed through ARDL model and asymmetry impacts on the GDP per capita from those determinants were econometrically examined by NARDL model. The empirical observations showed that GDP per capita is positively related with income inequality and human development index or inversely related with wealth inequality and unemployment rate in which cointegrating relation is convergent and significant. ARDL estimate implies that GDP per capita is positively related with income inequality of current period, inversely related with wealth inequality, human development index and unemployment rates in previous years. The model is stable without serial correlation and heteroscedasticity problems. Asymmetry impacts from income inequality, human development index and unemployment rate were visible while symmetry impact from wealth inequality was seen in NARDL model during 1990-2025.

Keywords: GDP per capita, income inequality, wealth inequality, human development index, unemployment rate, asymmetry, cumulative dynamic multiplier, positive changes, negative changes.

JEL classification codes-C22, C32, D63, E24, J64, O15, O4.

Introduction

The nexus between economic inequality and economic growth (or increase in GDP per capita) is complex in the short run as well as in the long run. In the cycles of income both income inequality and wealth inequality do not move according to the normal theory in which inequality increases but economic growth decreases. In the same way, increase in human development and employment do not always decrease inequality or increase in unemployment does not necessarily decline economic growth while it depends on many other factors. In the NARDL model in the analysis of long run, the relationships are nonlinear and the variables are inter-related with different periods. In Western Balkan countries during 2006-2023 the empirical study showed that HDI has positive relation with GDP in the long run while negative relation between unemployment and HDI is not the same in all countries (Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, Serbia) (Nazarko & Hoxha,2025).

India's inequality is harmful to economic stability and social harmony in which the policy of reduction in inequality requires huge investment in education and health as well as increase in productivity and income in which income distribution will favour towards sustainable development (Mangave,2025).

In India during 1996-2021, ARDL model concluded that in the short run, the relation between unemployment rate and income inequality is positive while economic growth is negatively related with income inequality. Globalisation has positive impact on income inequality. In the long run, unemployment, governance and income inequality is positively related significantly (Basumatary,2025).

Received 8 **May 2026**; Accepted **25 May 2026**. Available online: **30 May 2026**. Published by SAFE. (Society for Academic Facilitation and Extension)

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In BRICS countries, it was verified that human development is positively influenced by financial inclusion which improved gender inequality using data from the Global Findex Database 2021 to develop a Finclusion Index in 105 countries (Pandey,2023).

In this paper, the nexus between GDP per capita, income inequality, wealth inequality, human development index and unemployment rate in India during 1990-2025 has been empirically studied through application of ARDL model and explained asymmetry impacts on GDP per capita using NARDL model where both short run and long run relationships were found out under distributed lag in linear and nonlinear forms.

Objective of the paper

The paper tried to relate GDP per capita with income inequality, wealth inequality, human development index and unemployment rate of India from 1990 to 2025 with the help of Auto Regressive Distributed Lag model and verified the asymmetric impact of income inequality, wealth inequality, human development index and unemployment rate on GDP per capita by using Non-linear Auto Regressive Distributed Lag model.

Literature Review

In arguing the relationship between economic growth, human development and freedom, Sen (1999) hypothesized that economic growth is a mean to an end not an end in itself where human development is a measure of well-being and freedom is the ultimate goal of development.

As inequality rises, inequality adjusted HDI is less than HDI. When HDI increases, per capita GDP increases and inequality reduces where distribution of HDI is important which was empirically verified by Principal Factor Analysis in 103 countries taking 22 variables in the years 1995,2000,2005 and 2010(Foster, Lopez-Calva & Szekely,2005).

There is reciprocal linkage between human development index and unemployment rate and direct relation with GDP per capita which was evident in Western Balkan countries during 2006-2023(Nazarko & Hoxha,2025). HDI is positively correlated with GDP per capita (Singh et al. ,2025).

HDI is inversely related with unemployment rate and the long run relation is cyclical which was studied in Brazil, Mexico, Costa Rica and Uruguay during 1990-2021(Susich, 2024). Higher HDI reduces unemployment rate and can alleviate poverty which was empirically verified in East Java during 2019-2021 through Random Effect Model (Aji, Fisebilillah, Auggracui & Maulida,2024).

GDP per capita is positively associated with human development index which was empirically verified in ASEAN-10 during 2010-2016 (Elistia & Syahzuni,2018).

Cross country data of high, medium and low human development countries suggested that the relation between GDP per capita and human development index is inverted U shaped (Islam, 1995).

In India during 1991-2016, the cointegration analysis showed that the growth and unemployment rate is negatively related

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and cointegrated at 10% significant level (Bhowmik, 2018).

By applying cointegration and VECM during 1980-2022 in Ethiopia, it was found that in the short run, income inequality is inversely related with real GDP but it is positively associated in the long run (Ali &Asfaw,2023).

In Indonesia during 2005-2018, it was empirically found that income inequality has positive influence on unemployment rate but negative influence on human development index in case of cointegration analysis (Taresh & Purwono,2021).

In India during 1951-2023, the empirical cointegration model concluded that unemployment rate is positively associated with income inequality and negatively associated with GDP growth rate (Bhowmik,2024).

During 1995-2023 in India, the NARDL model suggested that income inequality is negatively associated with GDP growth rate which is inversely related with wealth inequality. Both positive and negative changes of the cumulative dynamic multiplier of income inequality are positively cointegrated with GDP growth rate significantly in the long run. But, in the short run, positive and negative changes of cumulative dynamic multiplier of incremental income inequality have positive and negative impacts on incremental GDP growth rate significantly. Asymmetry lines are not convergent (Bhowmik,2025).

A lower unemployment rate has improved GDP per capita in OECD countries which was empirically verified using OLS methodology (O'Martins,2020).

In Malaysia, unemployment is relatively more exogenous and GDP is more endogenous so that boosting economic growth needs rising standard of living (Liyana & Masih,2018).

In USA, in the longer period of 50 years, econometric model found out that a slow or decreasing growth rate can increase unemployment rate significantly during 1967-2016 using multiple regression analysis (Mandel & Liebens,2019).

Sanchez and Liborio (2012) used Okun's technique during 1949-2009 in USA and found that in recessionary period, unemployment to population ratio declined while in recovery period, the ratio increased.

In India, during 1991-2024, Granger causality and correlation test suggested that unemployment rate is negatively correlated with economic growth and there is no Granger causality in both directions where inclusive growth process is necessary (Htun,2025).

By examining 165 countries during 1995-2019, using GMM methodology, it was found that one standard deviation increase in Gini index is associated with a decrease of 0.34 per cent in annual growth rate which is significant (Steenbrink & Skali,2026).

In 193 countries during 1990-2021 the empirical study estimated that human development is positively related with GDP per capita, and increase in Gini implies an increase in GDP per capita. Besides, gender inequality index is positively related with GDP per capita significantly (Mandegar & Olsson,2023).

In India during 2000-2024, the correlation analysis concluded that increase in income inequality has decreased GDP growth

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rate where rise in top 10% income share and bottom 50% income share decreased and Gini index has risen (Yadav,2024).

Methodology and Sources of Data

The verification of Stationary or non-stationary series was done by ADF test of Dicky and Fuller (1979) which is known as unit root test. Derivation of ARDL (p, q) model was calculated with the help of Pesaran and Shin (1997) where Bounds test was evaluated through Pesaran et al (2001) model. The serial correlation and LM heteroscedasticity tests were done by applying Breusch and Pagan (1979) model. Asymmetry test was applied by the help of Shin et al. (2014) model. Page (1954) model was used for finding stability in terms of CUSUM line.

The data on India's GDP per capita in US$ at current prices from 1990 to 2025 were collected from the World Bank. The data on India's income inequality and wealth inequality from 1990 to 2025 was collected from the World Inequality Data Lab where h10-h50=income inequality and income shares of top 10% and bottom 50% data were collected. Similarly, w10-w50 =wealth inequality where the data on top10% share and bottom 50% share of wealth were collected. The data on human development index of India from 1990 to 2025 were collected from UNDP: India's Human Development Index, 2025.And the data on unemployment rate as percent of total labour force from 1990 to 2025 were collected from the World Bank.

EMPIRICAL FINDINGS OF ARDL MODEL

[1] Unit Root Test

Unit root test through Augmented Dicky-Fuller test statistic at H0=has unit root confirmed that all the series (x_1=income inequality, x_2 =wealth inequality, x_3 =human development index, x_4=unemployment rate and y=GDP per capita) except unemployment rate are stationary and have no unit root in the first difference series while unemployment rate is non-stationary and has unit root in both level and first difference. All the calculated ADF values with tabulated at 5% and 10% level including probabilities and non-stationary/stationary have been given in the Table 1 below.

Table 1: Unit root test

variable	ADF (-2.9511 at 5% level and -2.614300 at 10% level tabulated value)	probability	Stationary/nonstationary
x_1	-1.594723	0.4743	x_1 has unit root and is non-stationary
d(x_1)	-2.817207	0.0664	$d(x_1)$has no unit root is stationary
x_2	-1.532409	0.5057	$x_2$has unit root and is non-stationary
d(x_2)	-5.716778	0.0000	d(x_2) has no unit root is stationary
x_3	.011207	0.9512	$x_3$has unit root and is non-stationary
d(x_3)	-6.662793	0.0000	$d(x_3)$ has no unit root is stationary
x_4	-0.503587	0.8762	$x_4$has unit root and is non-stationary
d(x_4)	1.096012	0.9965	d(x_4) has unit root and is non-stationary
y	2.358030	0.9999	y has unit root and is non-stationary
d(y)	-5.736252	0.0000	d(y) has no unit root and is stationary

Source-Calculated by author

[2] Estimated ARDL model

India's GDP per capita has been regressed by income inequality, wealth inequality, human development index and unemployment rate during 1990-2025 through Auto Regressive Distributed Lag model of

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(4,1,4,3,2) which was automatically selected from 2500 models where AIC is minimum with the assumptions of 4 lags having restricted constant and no trend. The estimated model is given below in Table 2.

Table-2: Estimated ARDL (4,1,4,3,2) model

Variable [dependent=$d(y_t)$]	coefficient	Standard error	t-statistic	probability
y_{t-1}	0.622180	0.208069	2.990257*	0.0104
y_{t-2}	-0.363894	0.219994	-1.654107	0.1220
y_{t-3}	-0.112969	0.231401	-0.488198	0.6335
y_{t-4}	-0.235275	0.212144	-1.109034	0.2875
x_{1t}	4940.704	1894.621	2.607753*	0.0217
x_{1t-1}	4627.035	2944.294	1.571526	0.1401
x_{2t}	-1296.806	1532.948	-0.845956	0.4129
x_{2t-1}	-3375.427	1459.929	-2.312048*	0.0378
x_{2t-2}	-648.5699	1642.721	-0.394814	0.6994
x_{2t-3}	2090.005	1345.706	1.553092	0.1444
x_{2t-4}	-4202.758	1273.471	-3.300238*	0.0057
x_{3t}	-2940.407	3318.760	-0.885996	0.3917
x_{3t-1}	-6839.178	2387.929	-2.864063*	0.0133
x_{3t-2}	-1213.043	1870.220	-0.648610	0.5279
x_{3t-3}	11542.70	2821.562	4.090891*	0.0013
x_{4t}	-165.7022	36.22812	-4.573855*	0.0005
x_{4t-1}	23.00622	54.03203	0.425789	0.6772
x_{4t-2}	-229.8122	46.99751	-4.889879*	0.0003
C	4397.667	1247.982	3.523821*	0.0037

Source-Calculated by author

Where R2=0.998, F=487.2856*, DW=2.54, AIC=10.78, SC=11.65, n=32, *=significant at 5% level, y=GDP per capita (US$ current), x_1=income inequality=h10-h50, x_2 =wealth inequality=w10-w50, x_3 =human development index, x_4=unemployment rate % of total labour force, h10=income share of top 10%,h50=income share of bottom 50%,w10=wealth share of top 10%,w50=wealth share of bottom 50%.

The estimate states that GDP per capita at current price is positively associated with previous period significantly, directly related with income inequality at current period, negatively related with wealth inequality in previous period, and previous 4-year period, negatively related with human development index of previous period and previous 3rd period, negatively related with unemployment rate of current period and previous 2nd period respectively. All of which are significant at 5% level. The model is highly significant with high R2 and F.

Bounds test is significant at 5% level where H0=no levels relationship showing 4 cointegrating relation with maximum lag 4. It was found that F statistic=6.2664 which is greater than the tabulated values at 5% level as well as 1% level.

Minimum AIC=10.788 was found from all verified models which is shown below in Figure 1.

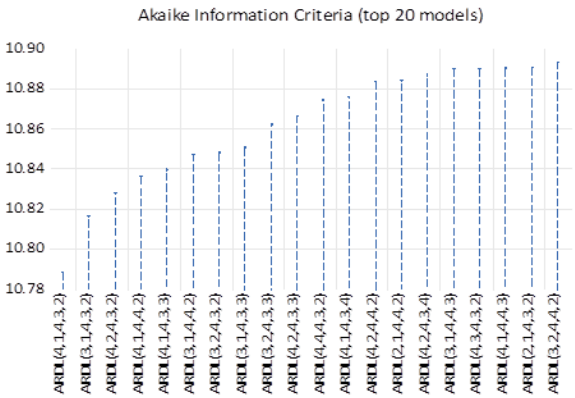

Figure-1: Automatically selected model
Source-Plotted by author

Thus, the estimated error correction model is found as below in Table 3.

Table 3: The Error Correction Model

Variable [$dependent = d(y_t)$]	coefficient	Standard error	t-statistic	probability
COINTEQ*	-1.089958	0.151063	-7.215256*	0.0000
d(y_{t-1})	0.712138	0.138204	5.152807*	0.0001
d(y_{t-2})	0.348245	0.111104	3.134404*	0.0057
d(y_{t-3})	0.235275	0.111951	2.101592*	0.0499
d(x_{1t})	4940.704	1186.925	4.162608*	0.0006
d(x_{2t})	-1296.806	943.6747	-1.374209	0.1862
d(x_{2t-1})	2761.323	1144.107	2.413518*	0.0267
d(x_{2t-2})	2112.753	916.5211	2.305187*	0.0333
d(x_{2t-3})	4202.758	909.0116	4.623437*	0.0002
d(x_{3t})	-2940.407	1730.950	-1.698724	0.1066
d(x_{3t-1})	-10329.66	1889.539	-5.466762*	0.0000
d(x_{3t-2})	-11542.70	1785.558	-6.464479*	0.0000
d(x_{4t})	-165.7022	18.31537	-9.047167*	0.0000
$d(x_{4t-1})$	229.8122	33.29537	6.902226*	0.0000

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Source-Calculated by author

Where R2=0.901, F=12.60*, AIC=10.47, SC=11.11, DW=2.54, n=32, d=first difference

The estimated Error Correction ARDL model implies that increment of GDP per capita is positively associated with increment of GDP per capita of previous three periods, increment of current income inequality, increment of wealth inequality of previous three periods, and increment of unemployment of previous period significantly. Moreover, increment of GDP per capita is negatively associated with increment of human development index of current period and previous two periods as well as increment of unemployment at current period significantly. The cointegrating relation is significant and negative which implies it is convergent.

The cointegration equation is given below.A=x_(4t-1)πr^2

CE = -1.089958y_(t-1)– [8778.080583x_(1t-1) - 6820.039016x_(2t-1) + 504.676200x_(3t-1)

(-7.21)* (7.60)* (-4.26)* (0.316)

- 341.763736x_(4t-1) + 4034.712177]

(-11.83)* (5.43)*

The cointegrating equation implies that GDP per capita is positively related with income inequality, and human development index or inversely related with wealth inequality and unemployment rate during 1990-2025 in which all are significant except human development index. The cointegrating coefficient is negative and significant which states that it is convergent but did not touch in equilibrium point because coefficient of human development index is insignificant.

The cointegrating equation is depicted in Figure 2 below.

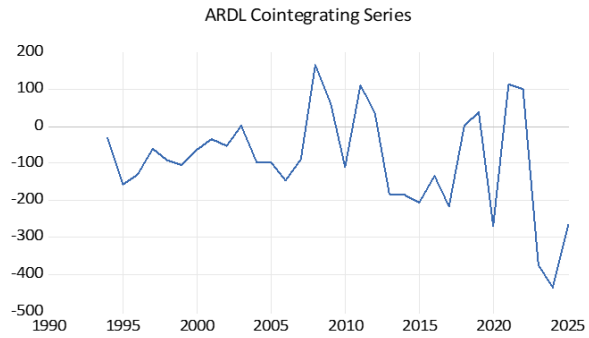

Figure 2: Cointegrating equation

Source-Plotted by author

This ARDL model is stable since its CUSUM of squares line passes through ±5% significant level which is shown in Figure 3 below.

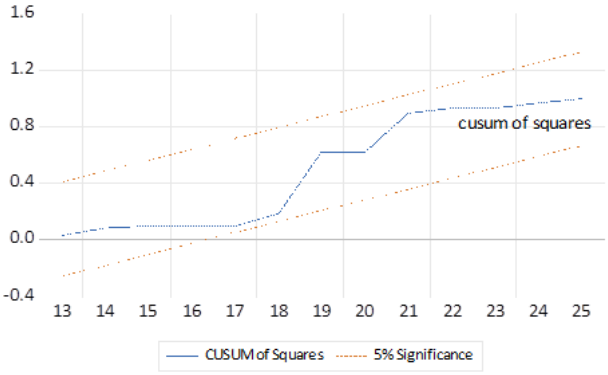

Figure 3: Stability of ARDL model

Source-Plotted by author

There is no problem of heteroscedasticity and serial correlation. Since, in Breusch-Godfrey Serial Correlation LM Test (lag 2), at H0= no serial correlation, nR2=9.6375 whose probability of Chi-square (2) =0.0081 and F (2,11) =2.3703 whose probability is 0.1393 which is accepted.

In Breusch-Pagan-Godfrey Heteroskedasticity Test at H0=homoscedasticity, nR2=23.22 whose probability of Chi-square (18) =0.18 and F (18,13) =1.911 whose probability =0.1190 which implies that there is no heteroscedasticity.

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ASYMMETRIC IMPACTS

[A] Asymmetry of Income Inequality

The ARDL (3,3) model is automatically selected where it was assumed that there will be maximum 4 lags and minimum AIC. Then, the increment of GDP per capita has been estimated to find out asymmetry of income inequality during 1990-2025.The estimated model is given below in Table 4.

Table 4: Asymmetry of income inequality

Variable [dependent= $d(y_t)$]	coefficient	Standard error	t-statistic	probability
(y_{t-1})	-0.180265	0.151671	-1.188526	0.2485
$cdmx^{+}_{1t-1}$	1229.017	745.3768	1.648853	0.1148
$cdmx^{-}_{1t-1}$	-9573.275	3441.925	-2.781372*	0.0115
C	-64.98666	50.12414	-1.296514	0.2096
$d(y_{t-1})$	-0.135178	0.221440	-0.610450	0.5484
$d(y_{t-2})$	-0.486010	0.212640	-2.285595*	0.0333
$d(cdmx^{+}_{1t})$	2096.415	2638.865	0.794438	0.4363
$d(cdmx^{-}_{1t})$	607.1050	6201.065	0.097903	0.9230
$d(cdmx^{+}_{1t-1})$	2922.406	2775.278	1.053013	0.3049
$d(cdmx^{-}_{1t-1})$	-3110.295	5486.856	-0.566863	0.5771
$d(cdmx^{+}_{1t-2})$	739.8215	2522.718	0.293264	0.7723
$d(cdmx^{-}_{1t-2})$	19869.94	6888.041	2.884702*	0.0092

Source-Calculated by author

Where R2=0.648, F=3.348*, DW=1.807, AIC=11.61, SC=12.16, n=32, *=significant at 5% level, *=significant at 5% level.

(cdmx_1t^+)=cumulative dynamic multiplier of positive changes of x1 at t, (cdmx_1t^-)= cumulative dynamic multiplier of negative changes of x1 at t, d=first difference

The estimated model implies that in the long run, the cumulative dynamic multiplier of negative response of income inequality of the previous year is negatively related with increment of GDP per capita significantly. On the other hand, in the short run, the increment of the cumulative dynamic multiplier of negative response of income inequality of the previous 2nd year is positively related with increment of GDP per capita significantly.

The bounds test assured that F=5.759 which is greater than the tabulated values of 1%,5%, and 10% significant level having H0=no levels relationship. So, bounds test is significant.

According to symmetry test at Ho=coefficient is symmetric, it was found that in the long run, F (1,20) =7.4747 whose probability is 0.0128 and Chi-square (2) =7.4747 whose probability is 0.0063 which are significant. While, in the short run, F (1,20) =1.51014 whose probability is 0.2334, and Chi-square (2) =1.51014 whose probability is 0.2191 which is insignificant.

In Figure 4, the asymmetry of income inequality on GDP per capita is depicted below. The positive response of cumulative dynamic multiplier of income inequality on GDP per capita tends to positive long run limit which is above the equilibrium level. On the contrary, the negative response of cumulative dynamic multiplier of income inequality on GDP per capita is convergent towards negative long run limit which is far below the equilibrium level and convex. The asymmetry line starting with cycles steeply moves upward but passes through significant confidence interval which is just opposite shape of negative response. (Asymmetric from negative responses)

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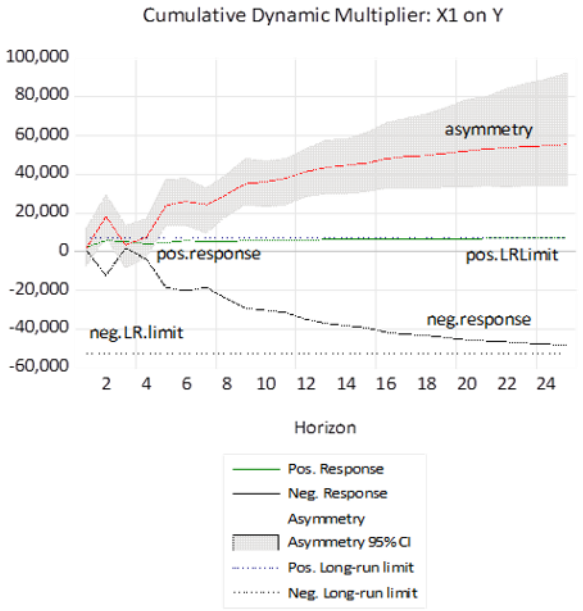

Figure 4: Asymmetry of income inequality
Source-Plotted by author

[B]Asymmetry of wealth inequality

The increment of GDP per capita has been estimated to find out asymmetry of wealth inequality during 1990-2025 after automatic selection of ARDL (2,1) model having maximum 4 lags and minimum AIC. The estimated model is given below in Table 5.

Table 5: Asymmetry of wealth inequality

Variable [dependent=$d(y_t)$]	coefficient	Standard error	t-statistic	probability
y_{t-1}	-0.011597	0.151148	-0.076727	0.9394
$cdmx^{+}_{2t-1}$	1061.798	668.1767	1.589098	0.1237
$cdmx^{-}_{2t-1}$	532.7033	2579.740	0.206495	0.8380
C	-32.43638	52.85397	-0.613698	0.5446
$d(y_{t-1})$	-0.291565	0.198313	-1.470224	0.1531
$d(cdmx^{+}_{2t})$	3343.328	1990.816	1.679375*	0.1046
$d(cdmx^{-}_{2t})$	6846.989	3727.306	1.836981*	0.0772

Source-Calculated by author

Where R2=0.477, F=4.115*, DW=2.02, AIC=11.65, SC=11.97, n=34, *=significant at 5% level, 〖cdmx〗_t^+ =cumulative dynamic multiplier of positive changes of xt, and 〖cdmx〗_t^-=cumulative dynamic multiplier of negative changes of xt.

In the long run, there is no significant impact of asymmetry of wealth inequality but in the short run, the increment of cumulative dynamic multiplier of both positive and negative response of wealth inequality at current level is positively associated with the increment of GDP per capita which are significant at 10% level.

The bounds test confirms that F=5.182369 which is greater than the tabulated values of 1%,5% and 10% significant levels.

The symmetry test at H0=coefficient is symmetric has been conducted. It was found that F (1,27) =0.032298 whose probability is 0.8574 and Chi-square (1) =0.032298 whose probability is 0.8574 in the long run while in the short run, F (1,27) =0.518237 whose probability is 0.4778 and Chi-square (1) =0.518237 whose probability is 0.4716.

The asymmetry impact of wealth inequality on GDP per capita in India during 1990-2025 is depicted in Figure 5 in which it was shown that both positive and negative responses are upward along with asymmetry line which are above the equilibrium level and lie between ±95% confidence interval (Symmetrical)

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Journal home page: https://integralresearch.in/
Vol. 03, No. 05, May. 2026

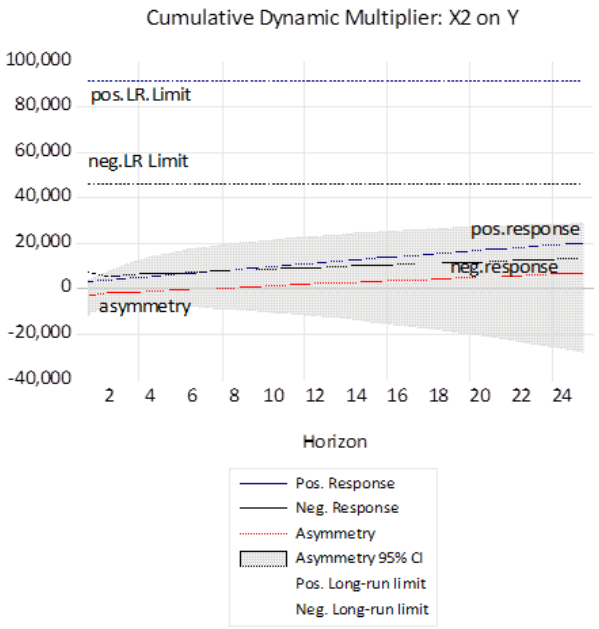

Figure 5: Asymmetry of wealth inequality
Source-Plotted by author

[C] Asymmetry of human development index

The ARDL (1,2) model assuming maximum 4 lags and minimum AIC, has been automatically selected to estimate the increment of GDP per capita to find out asymmetry of human development index during 1990-2025.The estimated model is given below in Table 6.

Table 6: Asymmetry of human development index

Variable [dependent=$d(y_t)$]	coefficient	Standard error	t-statistic	probability
y_{t-1}	-0.242574	0.098850	-2.453973*	0.0214
$cdmx^{+}_{3t-1}$	2573.151	840.7546	3.060525*	0.0052
$cdmx^{-}_{3t-1}$	-25636.29	6893.224	-3.719057*	0.0010
C	55.90209	33.08066	1.689872*	0.1035
$d(cdmx^{+}_{3t})$	-2390.731	2955.743	-0.808843	0.4262
$d(cdmx^{-}_{3t})$	4249.967	11192.27	0.379724	0.7074
$d(cdmx^{+}_{3t-1})$	-6270.807	2245.049	-2.793171*	0.0099
$d(cdmx^{-}_{3t-1})$	57793.80	16086.49	3.592692*	0.0014

Source-Calculated by author

Where R2=0.609, F=5.577*, DW=2.041, AIC=11.45, SC=11.82, n=33, *=significant at 10% level, cdm=cumulative dynamic multiplier, d=first difference, 〖cdmx〗_t^+ =cumulative dynamic multiplier of positive changes of xt, and 〖cdmx〗_t^- =cumulative dynamic multiplier of negative changes of xt.

In the long run, the cumulative dynamic multiplier of positive response of human development index of previous year has significant positive impact on increment GDP per capita while the cumulative dynamic multiplier of negative response of human development index of previous year has significant negative impact on increment GDP per capita. On the other hand, in the short run, the increment of the cumulative dynamic multiplier of positive response of human development index of previous year has significant negative impact on increment GDP per capita and the increment of the cumulative dynamic multiplier of negative response of human development index of previous year has significant positive impact on increment GDP per capita.

According to the bound test, at null hypothesis H0=no levels relationship, it was confirmed that F=6.713 which is greater than the tabulated values of 1%,5%, and 10% levels of significance.

The symmetry test, at H0= Coefficient is symmetric, it was shown that in the long run, F (1,25) =15.641 and its probability is 0.0006 and Chi-square (1) =15.641 whose probability is 0.0001 while in the short run, F (1,25) =6.284 and its probability is 0.019 and Chi-square (1) =6.284 whose probability is 0.0122 respectively (Asymmetry).

Received 8 **May 2026**; Accepted **25 May 2026**. Available online: **30 May 2026**. Published by SAFE. (Society for Academic Facilitation and Extension)

Integral Research
(ISSN: 3048-5991) Coden: IRABCA
Research Article
(Peer-reviewed, Open Access & Indexed Multidisciplinary Journal)
Journal home page: https://integralresearch.in/
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The asymmetry impact of HDI on GDP per capita is depicted in Figure 6 below. Both the positive response and negative response of cumulative dynamic multiplier of human development index on GDP per capita during 1990-2025 merged towards long run limits in which positive response is above the equilibrium level and negative response is below the equilibrium level. The asymmetry line is strictly upward and lies within ±95% confidence interval. (Asymmetry arises from both positive and negative responses).

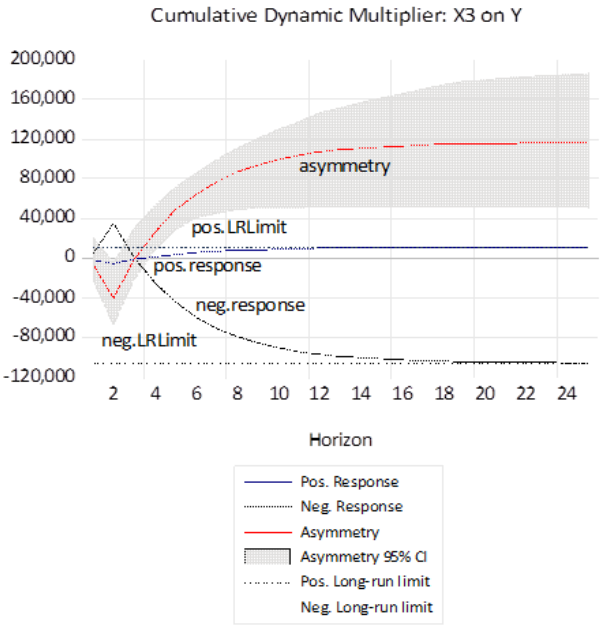

Figure 6: Asymmetry of human development index
Source-Plotted by author

[D] Asymmetry of unemployment rate

The ARDL (1,1) model with the assumption of maximum 4 lags and minimum AIC has been automatically selected to estimate the increment of GDP per capita to examine the asymmetric impact of unemployment rate during 1990-2025.The estimated model is given below in Table 7.

Table 7: Asymmetry of unemployment rate

Variable $[d(y_t) = dependent]$	coefficient	Standard error	t-statistic	probability
y_{t-1}	0.005346	0.029713	0.179923	0.8585
$cdmx^{+}_{4t-1}$	291.6284	102.5381	2.844097*	0.0082
$cdmx^{-}_{4t-1}$	76.17952	30.51795	2.496220*	0.0187
C	25.11847	24.89632	1.008923	0.3217
$d(cdmx^{+}_{4t})$	-132.3879	59.33507	-2.231191*	0.0339
$d(cdmx^{-}_{4t})$	80.80822	55.23430	1.463008	0.1546

Source-Calculated by author

Where R2=0.542, F=6.646*, DW=2.238, AIC=11.46, SC=11.73, n=34, *=significant at 5% level, 〖cdmx〗_t^+ =cumulative dynamic multiplier of positive changes of xt, and 〖cdmx〗_t^-=cumulative dynamic multiplier of negative changes of xt.

In the long run, both the cumulative dynamic multiplier of positive and negative responses of unemployment rate of previous year during 1990-2025 have significant positive impact on increment of GDP per capita. On the contrary, in the short run, the increment of cumulative dynamic multiplier of positive response of unemployment rate of current year has significant negative impact on increment of GDP per capita.

The bounds test at H0= No levels relationship showed that F=10.666 which is greater than the tabulated values of 1%,5% and 10% levels.

The symmetry test at H0= Coefficient is symmetric has been conducted and found that in the long run, F (1,28) =8.063 whose probability is 0.0083 and Chi-square (1) =8.063 and its probability is 0.0045 while in the short run, F (1,28) =8.466 and its probability is 0.007 and Chi-square (1) =0.0036. (asymmetry).

The asymmetry impact of unemployment rate on GDP per capita in India

Received 8 **May 2026**; Accepted **25 May 2026**. Available online: **30 May 2026**. Published by SAFE. (Society for Academic Facilitation and Extension)

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Research Article
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Journal home page: https://integralresearch.in/
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during 1990-2025 has depicted in Figure 7 below.

Both the positive and negative responses of cumulative dynamic multiplier of unemployment rate on GDP per capita are slowly upward above the equilibrium line as well as above the long run limits for which asymmetry line is moving upward above the equilibrium line and lies with the confidence interval of ±95%. (asymmetry).

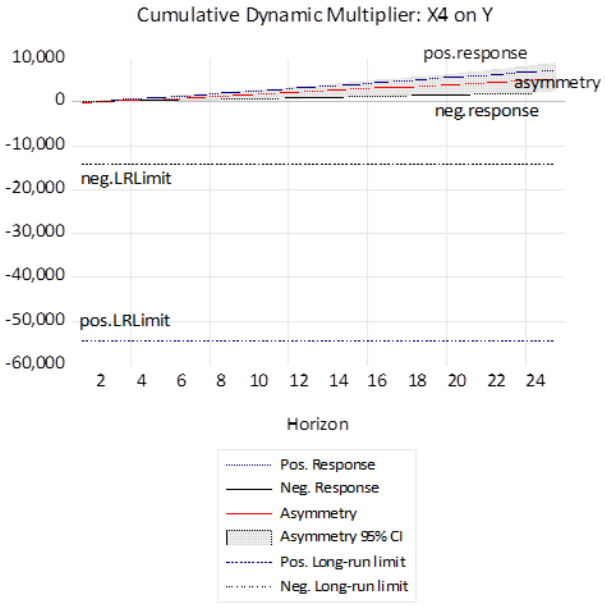

Figure 7: Asymmetry of unemployment rate
Source-Plotted by author

Consideration of Policies

Growth-led poverty alleviation programme and tax reforms in reducing wealth inequality will surely boost GDP per capita, HDI and employment potentialities. Although long run trends of HDI do not necessary confirm the reduction of unemployment rate in all countries. On the other hand, guarantee of higher employment may be helpful in catapulting HDI and economic growth. Increasing education and health expenditures must increase HDI which can accelerate growth and reducing inequality. Expanding public economy and increasing social sector expenditure are the positive actions behind the benefits of the model.

Discussions

In North Sumatra using fixed effect model in panel data during 2019-2023, it was verified that poverty and unemployment have significant positive impact on income inequality and HDI has negative effects in reducing inequality while economic growth showed insignificant impact on income inequality. Therefore, education and health reform, introduction of MSME, regional development and change in structural inequalities are urgent policy frameworks (Rizky, Lubis & Kesuma, 2024). The ARDL model suggested that India is not an exception to these above findings.

Income and wealth shares of top 10% and bottom 50% will not clarify all the corners of inequalities of a country and Gini coefficient and other indicators of well-being are crucial to explain. It is noted that increase in well-being is associated with high Gini index which is good for high human capital development that needs more investment in health and education since inequality is inversely associated with various dimensions of well-being (Kakwani & Son,2015).

Above all, political stability must be considered for sustainability and inclusive growth since it was found that in Nepal during 1991-2022, the empirical research showed that unemployment is negatively related with political stability and positively related with economic growth where economic growth is

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positively related with political stability. Thus, unemployment is directly associated with income inequality which has multiplier effects too. For sustainable development, the relation between these three are crucial (Dahal, Budhathoki, & Bhattarai,2024).

Limitations and future Scope of Research

If the time series data cover more longer term, then NARDL model and asymmetry impact would be more accurate and perfect so that policy prescriptions would be sustainable and justified. Unemployment rate can be classified as gender-based to assist gender budget policies. It is applicable to gender HDI also. Although there are many debatable issues on the concept of income and wealth inequalities because Gini coefficients are not available in every year. All these shortcomings might be modified in the future course of research.

Conclusions

The paper concludes that the estimated ARDL model implies that India's GDP per capita during 1990-2025 is positively related with income inequality at current period while negatively related with unemployment of current period and previous 2nd period, human development index of previous period and previous 3rd period and wealth inequality in previous period, and previous 4th year period respectively where there are no serial correlation and heteroscedasticity problems and the bounds test is significant. The model is stable.

The cointegrating relationships suggested that GDP per capita is positively related with income inequality, and human development index or inversely related with wealth inequality and unemployment rate during 1990-2025 where wealth inequality is insignificant.

Asymmetric impacts on GDP per capita emerge from income inequality, human development index and unemployment rate while symmetry impact comes from wealth inequality during 1990-2025.

In the long run, the cumulative dynamic multiplier of negative response of income inequality of the previous year is negatively related with increment of GDP per capita significantly. In the short run, the increment of the cumulative dynamic multiplier of negative response of income inequality of the previous 2nd year is positively related with increment of GDP per capita significantly.

The increment of GDP per capita is positively associated with the increment of cumulative dynamic multiplier of both positive and negative responses of wealth inequality at current level in short run while there is no significant relation in the long run.

In the long run, incremental GDP per capita is positively related with the cumulative dynamic multiplier of positive response of human development index and negatively related with negative responses of previous year while the incremental relation is negative in positive responses of previous year and positive in negative responses of previous year in the short run.

Increment in GDP per capita is negatively related with increment of cumulative dynamic multiplier of positive response of unemployment rate of current year

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Research Article
(Peer-reviewed, Open Access & Indexed Multidisciplinary Journal)
Journal home page: https://integralresearch.in/
Vol. 03, No. 05, May. 2026

in the short run and positively related with both positive and negative responses in the long run.

References:

1]Aji, T.S., Fisenbilillah, L.W.P., Anggracui, D.M., & Maulida, S.P. (2024). The impact of the human development index, unemployment and poverty on economic growth in East Java Province, Indonesia. In Y.A.Yusren et al. (Eds.), Proceedings of the 2023 Brawijaya International Conference (BIC,2023). Advances in Economics, Business and Management Research, 294. https://doi.org/10.2991/978-94-6463-525-6_52

2]Ali, A. K., & Asfaw, D. M. (2023, November 16). Nexus between inflation, income inequality, and economic growth in Ethiopia. PLoS One, 18(11): e0294454. https://doi.org/10.1371/ journal.

3]Basumatary, I. R. (2025). Effects of unemployment and governance quality on income inequality in India. http://14.139.213.3:8080/jspui/bitstream/123456789/492/9/09_chapter%205.pdf

4]Bhowmik, D. (2025). Asymmetry of Wealth and Income Inequality on GDP Growth Rate in India, The Lumbini Journal of Business and Economics ,13(1),1-17, 10.3126/ljbe.v13i1.80252

5]Bhowmik, D. (2024). Econometric Analysis on Unemployment, Inequality and Economic Growth in India. Saudi Journal of Economics and Finance. https://doi.org/10.36348/sjef.2024.v08i12.001

6]Bhowmik, D. (2018). Econometric Test on Growth-Unemployment Nexus in India, Journal of Quantitative Methods, University of Management and Technology, Lahore, Pakistan, vol. 2(2), pages 56-74. Handle: RePEc:ris:jqmumt:0016

7]Breusch, T. S., & Pagan, A. R. (1979). A Simple Test for Heteroscedasticity and Random coefficients variation. Econometrica, 47(5), 1287–1294. DOI: 10.2307/1911963

8]Page, E. S. (June 1954). Continuous Inspection Scheme. Biometrika, 41 (1/2),100–115. . hdl: 10338.dmlcz/135207. JSTOR 2333009DOI: 10.1093/biomet/41.1-2.100

9]Dahal, A. K., Budhathoki, P.B., & Bhattarai, G. (2024). Nexus between Unemployment, Income Inequality, Political Stability, and Economic Growth: An Empirical Study of the Nepalese Economy. Valahian Journal of Economic Studies,15(29), Issue-1, https://doi.org/10.2478/vjes-2024-0001

10]Dickey, David., & Fuller, Wayne A. (1979, June). Distribution of the estimates for autoregressive time series with a unit root. Journal of the American Statistical Association,74,427-31. https://www.tandfonline.com/doi/abs/10.1080/01621459.1979.10482531

11]Elistia, E., & Syahzuni, B.A. (2018). The correlation of the Human development index towards economic growth (GDP per capita) in 10 ASEAN member countries. Journal of humanities and social studies, 02, Number 02, 40-46. https://doi.org/10.33751/jhss.v2i2.949

12]Foster, J.E., Lopez-Calva, L.F., & Szekely, M. (2005). Measuring the distribution of Human Development: Methodology and Application to Mexico. Journal of Human Development,6,5-25. https://doi.org/10.1080/14649880520000342220

13]Htun, N. M. (2025). The Relationship between Economic Growth and Unemployment in India. International Journal of Research in Entrepreneurship & Business Studies, 6(2), 37-48. https://doi.org/10.47259/ijrebs.2025.624

14]Islam, S. (1995). The human development index and per capita GDP. Applied Economics Letters, 2(5), 166–167. https://doi.org/10.1080/135048595357537

15]Kakwani, N., & Son, H. H. (2015). Income inequality and social well-being. This paper is presented at the Expert Group Meeting on Sustainable Development and Agenda 2030

Received 8 **May 2026**; Accepted **25 May 2026**. Available online: **30 May 2026**. Published by SAFE. (Society for Academic Facilitation and Extension)

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Journal home page: https://integralresearch.in/
Vol. 03, No. 05, May. 2026

organized by the United Nations in New York on 21–23 October 2015. https://www.un.org/esa/socdev/egms/docs/2015/sd-agenda2030/Hyun-Son.pdf

16]Liyana, A., & Mansur, M. (2018). Does unemployment rate lead GDP growth or the other way around? Malaysia's case, MPRA Paper 102459, University Library of Munich, Germany. Handle: RePEc:pra:mprapa:102459

17]Mandegar, D., & Olsson, M. (2023). Examining the Relationships between GII, HDI, Gini, and GDP per capita: A Comparative Analysis of Undeveloped and Developed Countries (1990-2021). Bachelor's thesis in Economics, Department of Economics School of Business, Economics and Law University of Gothenburg. https://gupea.ub.gu.se/server/api/core/bitstreams/1135c20e-bf61-4dd4-a258-c3344057e65c/ content

18]Mangave, D. (2025, December). Income Inequality in India: Causes, Consequences, and Lessons from Developed Economies. https://mpra.ub.uni-muenchen.de/126773/ MPRA Paper No. 126773, posted 19 Nov 2025 04:31 UTC

19]Nazarko, B.K. & Hoxha, S. (2025). Assessment of the Impact of GDP, Employment, and Unemployment on the Human Development Index (HDI) for Western Balkan Countries (2006 2023). European Scientific Journal, ESJ, 21 (34), 121. https://doi.org/10.19044/esj.2025.v21n34p121

20]O'Martins, U. N. (2020). The Correlation Between Unemployment Rate, GDP Per Capita, and Adult Obesity Prevalence in Developed Economies. Evidence from OECD Member Countries. Walden Dissertations and Doctoral Studies. 8322. https://scholarworks.waldenu.edu/dissertations/8322

21]Pandey, T.D. (2023). Impact of Financial Inclusion on Human Development Index: Special Reference to BRICS Countries. BRICS Journal of Economics, 4(2), 209-223. https://doi.org/10.3897/brics-econ.4.e96288

22]Pesaran, M., & Shin, Y. (1999). An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis. In Strom, S. (Ed.), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch centennial Symposium. Cambridge University Press., https://www.scirp.org/reference/referencespapers?referenceid=2431050 DOI: 10.1017/CCOL521633230.011

23]Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationship. Journal of Applied Econometrics, 16(3), 289–326. https://www.jstor.org/stable/2678547. DOI: 10.1002/jae.616

24]Rizky, M. D., Lubis, S. N., & Kesuma, S. I. (2024). Economic Growth, Poverty, Unemployment, and the Human Development Index (HDI) in Mitigating Socio-economic Disparities in North Sumatra (2019-2023): An Econometric Case Study. South Asian Journal of Social Studies and Economics, 21(12), 302–311. https://doi.org/10.9734/sajsse/2024/v21i12938

25] Sánchez, J.M., & Liborio, C.S.(2012,May).The Relationships Among Changes in GDP, Employment, and Unemployment: This Time, It's Different, St. Louis Fed On the Economy, https://www.stlouisfed.org/on-the-economy/2012/may/the-relationships-among-changes-in-gdp-employment-and-unemployment-this-time-its-different

26]Sen, A. (1999). Development As Freedom. OUP.

27]Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in an ARDL Framework. In Sickles, R. C., & Horrace, W. C. (Eds.), Festschrift in Honor of Peter Schmidt. Springer Science and Business Media., https://pure.york.ac.uk/portal/en/publications/mo

Received 8 **May 2026**; Accepted **25 May 2026**. Available online: **30 May 2026**. Published by SAFE. (Society for Academic Facilitation and Extension)

delling-asymmetric-cointegration-and-dynamic-multipliers-in-a-n DOI: 10.1007/978-1-4899-8008-3_9

28]Singh, K., Cheemalapati, S., RamiReddy, S. R., Kurian, G., Muzumdar, P., & Muley, A. (2025). Determinants of Human Development Index (HDI): A regression analysis of economic and social indicators. Asian Journal of Economics, Business and Accounting, 25(1), 26–34. https://doi.org/10.127030/AJEBA.127030

29]Steenbrink, R., & Skali, A. (2026). Wealth inequality and economic growth: Evidence from the World Inequality Database, World Development,199, https://doi.org/10.1016/j.worlddev.2025.107250.

30]Susich, M. (2024). HDI and standard of living: A Panel Data Analysis of Latin America. Bryant University. https://digitalcommons.bryant.edu/eeb/vol17/iss1/5/

31]Taresh, A., Sari, D. W., & Purwono, R. (2021). Analysis of the relationship between income inequality and social variables: Evidence from Indonesia. Economics and Sociology, 14(1), 103-119. https://doi.org/10.14254/2071-789X.2021/14-1/7

32]Yadav, M. (2024, December). Economic Expansion and Wealth Disparities: Analyzing the Relationship Between GDP and Income Inequality in India. International Journal of Advanced Research in Science, Communication and Technology,4(3),879-888. DOI: 10.48175/IJARSCT-30653

Received 8 **May 2026**; Accepted **25 May 2026**. Available online: **30 May 2026**. Published by SAFE. (Society for Academic Facilitation and Extension)