

aarthika charche

FPI Journal of Economics & Governance

- *Karnataka's Path and Challenges to Achieve a Trillion-Dollar Economy by 2031-32*
- *Sustainability of Fiscal Policy in India: Evidence and Implications from National and State Level Analyses*
- *District Mineral Foundation (DMF) Funds and Socioeconomic Development of Districts in Karnataka State*
- *Understanding Livelihood Vulnerability in Dry Regions: Insights from Karnataka*
- *State Financial Corporations and Development of MSMEs – A Case Study of Karnataka State Financial Corporation*
- *Decomposition of Socioeconomic Inequality in Child Stunting in India*
- *Public Health Expenditure, Fiscal Space and Capacity of Indian States*
- *Impact of Financial Inclusion on India's Regional Economic Growth : Evidence from Rajasthan*
- *India's Macro Fundamentals and Rupee-Dollar Exchange Rate Volatility : Results from Simple Sum and Divisia Money Measures*
- *Electric Vehicle Landscape in India: An Analysis of Two Wheeler Electric Vehicles Market Trends and Economic Policy Implications*



Government of Karnataka
FISCAL POLICY INSTITUTE



aarthika charche

FPI Journal of Economics & Governance

Aims and Scope of the Journal

Aarthika Charche is a bi-annual journal brought out by Fiscal Policy Institute, Government of Karnataka, Bengaluru. Addressed to practitioners, academics, government and non-government entities, the aim of the journal is to feature articles which bring an innovative, insightful, and influential view-point on financial and fiscal issues in government and governance. Aarthika Charche is now recognised by protocols of University Grants Commission (UGC) in India as an academic journal under UGC-Consortium for Academic and Research Ethics (CARE) - Reference List of Quality Journals-Group I (Social Sciences).

Editor-in-Chief

Dr M. R. Narayana, Fiscal Policy Institute, Bengaluru

Editorial Advisory Board

- Dr David E. Bloom**, Clarence James Gamble Professor of Economics and Demography, Harvard T.H. Chan School of Public Health, Department of Global Health and Population, Harvard University, Boston, USA
- Dr Pinaki Chakraborty**, Vice Chairman, Institute of Development Studies, Jaipur, & Former Director & Professor, National Institute of Public Finance and Policy, New Delhi
- Dr Sonalde Desai**, Distinguished University Professor at the University of Maryland, USA, and Professor at National Council of Applied Economic Research, New Delhi
- Dr Mridul Eapen**, Honorary Fellow, Centre for Development Studies, Thiruvananthapuram
- Dr Jyotsna Jha**, Former Director, Centre for Budget and Policy Studies, Bengaluru
- Dr K.J. Joseph**, Director & Professor, Gulati Institute of Finance and Taxation, Thiruvananthapuram.
- Dr K.P. Krishnan**, Former Honorary Research Professor, Centre for Policy Research, New Delhi
- Dr S.S. Meenakshisundaram**, Visiting Professor, National Institute of Advanced Studies, Bengaluru
- Dr Arnab Mukherji**, Professor of Public Policy, Indian Institute of Management Bangalore, Bengaluru
- Dr N.R. Vasudeva Murthy**, Emeritus Professor of Economics & Finance, Creighton University, Omaha, Nebraska, U.S.A.
- Dr D. Rajasekhar**, Director & HAG Professor, Institute for Social and Economic Change, Bengaluru
- Dr Padma Sarangapani**, Professor and Chairperson, Centre of Excellence in Teacher Education, Tata Institute of Social Sciences, Mumbai Campus, Mumbai
- Dr K. Shanmugham**, Former Director & Professor, Madras School of Economics, Chennai
- Dr T.S. Somashekar**, Professor of Economics, National Law School of India University, Bengaluru
- Dr M.H. Bala Subrahmanya**, Professor, Department of Management Studies, Indian Institute of Science, Bengaluru

Editorial Team

Managing Editor : **Dr Vishal R, IAS**, Fiscal Policy Institute, Bengaluru

Assistant Editor : **Dr Ramanjini**, Fiscal Policy Institute, Bengaluru

aarthika charche

FPI Journal of Economics & Governance

Contents

<i>Editorial</i>	03
<i>Karnataka's Path and Challenges to Achieve a Trillion-Dollar Economy by 2031-32</i>	05
<i>- Mathew Koshy Odasseril and K. R. Shanmugam</i>	
<i>Sustainability of Fiscal Policy in India: Evidence and Implications from National and State Level Analyses</i>	19
<i>- Duragesh Pujari, Shreya Suppannavar and R .R . Biradar</i>	
<i>District Mineral Foundation (DMF) Funds and Socioeconomic Development of Districts in Karnataka State</i>	42
<i>- Shashwat N Doshetti and Pushpa M Savadatti</i>	
<i>Understanding Livelihood Vulnerability in Dry Regions: Insights from Karnataka</i>	56
<i>- Ramesh S Kampli and S.T. Bagalkoti</i>	
<i>State Financial Corporations and Development of MSMEs – A Case Study of Karnataka State Financial Corporation</i>	74
<i>- Dileep Kumar S D</i>	
<i>Decomposition of Socioeconomic Inequality in Child Stunting in India</i>	88
<i>- Santosh Tamang and Uttam Kumar Sikder</i>	
<i>Public Health Expenditure, Fiscal Space and Capacity of Indian States</i>	99
<i>- Deyona Rose Saji and S Madheswaran</i>	
<i>Impact of Financial Inclusion on India's Regional Economic Growth : Evidence from Rajasthan</i>	115
<i>- Aashi Jain and C.R. Bishnoi</i>	
<i>India's Macro Fundamentals and Rupee-Dollar Exchange Rate Volatility : Results from Simple Sum and Divisia Money Measures</i>	130
<i>- Topunuru Kaladhar</i>	
<i>Electric Vehicle Landscape in India: An Analysis of Two Wheeler Electric Vehicles Market Trends and Economic Policy Implications</i>	147
<i>- Sanoop M S</i>	
<i>Book Review</i>	160



Editorial



This is 17th regular Edition of our Journal, and published with a separate Special Issue on Local Finances and Development.

This regular edition comprises ten research articles on the current economic policy issues at national, state and district levels. The range of subjects includes the growth path and challenges to achieve a trillion-dollar economy by 2031-32, sustainability of fiscal policies, district mineral foundation funds and socio-economic development, understanding livelihood vulnerability in dry regions, State Financial Corporations and development of MSMEs, public health expenditure and fiscal space and capacities, decomposition of socio-economic inequality in child stunting, financial inclusion and economic growth, macro fundamentals and rupee-dollar exchange rate volatility, and economic policy implications of electric vehicles markets. Scope of these topics ranges from national to state and local (district) levels and, hence, policy analyses and implications also vary by these ranges. Karnataka state issues are mainly focused in five articles and broadly implied in the rest. Written by researchers from the premier academic and research institutions in India, each article is distinguishable by its contribution to evidence-based policy analyses and implications.

In addition, this Edition includes a book review on FISCAL POLICY IN A TURBULENT ERA, edited by Enrique Alberola and published by Edward Elgar Publishing Limited. Cheltenham (UK).

I am thankful to Sri. L. K. Atheeq, Additional Chief Secretary (Finance Department), Government of Karnataka and Chairperson, Governing Council, Fiscal Policy Institute, for his support, guidance, and encouragement for all initiatives and endeavours for improvement of this Journal.

Dr Vishal R
Director

Grateful thanks are due to all the distinguished contributors for their evidence-based and policy insightful articles, and internal and external experts for peer reviewing of the articles. These articles use the time series or cross-sectional macro data at national and sub-national levels and cross-sectional micro data from small sample surveys. Inferential foundations are strengthened by applications of rigorous statistical and econometric estimation methods. Further, these articles bring in best lessons from the national, state and local level experiences and practices for policy design and implementation at national and sub-national levels in India.

We are thankful to the Edward Elgar Publishing Limited. Cheltenham (UK) for continued patronage of latest books for Book Review in our Journal. In addition, all members of the Editorial Advisory Board and Editorial Team are thanked for their professional contributions and support for development of our Journal.

M.R. Narayana
Editor-in-Chief

Karnataka's Path and Challenges to Achieve a Trillion-Dollar Economy by 2031-32

Mathew Koshy Odasseril¹ and K. R. Shanmugam²

Abstract

This study examines whether Karnataka economy will reach the target of US \$ 1 trillion economy by 2031-32, given its current growth regime, inflation and rupee depreciation. A simple arithmetic procedure employed indicates that assuming an inflation rate of 4.5% and 2% exchange rate depreciation per annum, the Karnataka economy needs to grow at a real growth of 12.88% per annum for 9 consecutive years from 2023-24 to 2031-32 to reach the target. Alternatively, it examines a model based forecasts of the real growth for the future years and shows that Karnataka can reach the target in 2036-37. It also examines two other possible scenarios in which the target can be achieved in 2035-36 and 2034-35 respectively. Further, this study suggests multiple growth strategies including faster growth of sub sectors, maintaining high investment rate and obtaining sustainable threshold level of public debt by containing the fiscal deficit to only 2% level.

JEL Classification Codes: C22, C51, E32, E37, E66

1. Introduction

Karnataka is a better performing state in the country. It is the third-largest state economy with a nominal GSDP of Rs. 22.7 lakh crore (in 2022-23). It ranks second in per capita income (Rs. 3.04 lakh), next to Telangana (Rs. 3.12 lakh). It is also the second fastest growing major Indian state, with a 11-year (2012-13 to 2022-23) average real growth rate of 7.51%, next only to Gujarat (8.33%). After the pandemic, its average growth from 2021-22 to 2023-24 has increased to 8.94%.³ Karnataka ranks second in cumulative FDI inflow (from 2020-21 to 2022-23) with US\$ 410,172, next only to Maharashtra with US\$ 46,415.⁴ Karnataka ranks third in the Export Preparedness Index of Niti Aayog (2022) with a score of 76.36, next only to Maharashtra (78.2) and Tamil Nadu (80.89).

As Karnataka contributes more than 8% to the national GDP, its role in achieving India's ambitious target of a US\$ 7 trillion economy by 2030 will obviously be more important/significant. Interestingly, Karnataka sets itself a goal of achieving one trillion-dollar economy by 2031-32 (and US\$ 500 billion economy in 2025-26).⁵

It is a well-known fact that the COVID-19 pandemic affected all economies, including Karnataka economy. Its real GSDP growth rate registered a negative growth of -2.30% in 2020-21 and the growth of more than half of sub-sectors (fishing and aquaculture, manufacturing, construction, a sector comprising trade, repair, hotels and restaurants, a sector comprising transport, storage, communication & services

¹ Research Scholar, Madras School of Economics, Chennai, India. E-mail: mathewkoshy094@gmail.com

² Director and Professor, Madras School of Economics, Chennai, India. E-mail: shanmugam@mse.ac.in (corresponding author)

³ Thus, Karnataka has exhibited a remarkable resilience, evidenced by its strong rebound after COVID-19 pandemic effect.

⁴ In an official statement in May 2023, the Chief Minister of Karnataka has asked his administration to executive the recommendations of report prepared by the Planning Department committee to scale up the state economy to create massive opportunities for the people of Karnataka.

⁵ The source is: the answer to the Rajya Sabha unstarred question no. 215 on 21st July 2023.

related broadcasting, public administration and other services) contracted in that year. India's GDP also declined by -5.78%. The overall Indian economy faces many challenges including high levels of inflation, an unstable rupee and a large current account deficit. The recent Russia-Ukraine war has also aggravated the challenges faced by the economy. These factors may also have significant effects on state economies.

Further, the COVID-19 pandemic affected the government finances of the centre and almost all states, including Karnataka. While Karnataka was the first state in the country to enact the Karnataka Fiscal Responsibility Act 2002 and managed its finances well till 2019-20 (it kept its fiscal deficit below 3% level and the public debt (outstanding liabilities)-GSDP ratio below 20% level), its government finances deteriorated from 2020-21. Its outstanding liabilities increased to 25.68% of GSDP in 2020-21 and 25.48% in 2021-22, but slightly declined to 23.03% in 2022-23. According to the recent budget, the total outstanding debt of Karnataka will reach Rs. 6.65 lakh crore at the end of the fiscal year 2024-25, i.e., the debt-GSDP ratio will reach 23.7%, as against the 20% ceiling suggested by the new Fiscal Responsibility and Budget Management (FRBM) Review Committee headed by Shri N.K. Singh. This high debt-GSDP ratio may be a hindrance to the growth of Karnataka economy.

Given this background, the central question is: whether Karnataka economy will become one trillion-dollar economy by 2031-32? If yes, how much growth is needed to achieve this goal? Given the past trend in growth, when will Karnataka reach the target? To achieve the required growth rate, what are the growth strategies required in general and for the sub-sectors of the economy? Will the fiscal space facilitate the state to achieve its target? This study attempts to analyse these policy relevant issues.

2. Towards A US\$ Trillion Karnataka Economy

In the 2022-23 fiscal year, Karnataka's projected Gross State Domestic Product (GSDP) was Rs.22,69,995 crore, i.e., Rs. 22.699 trillion (= 0.28 US\$ trillion). In order to meet the target of US\$ 1 trillion Karnataka economy by 2031-32, the average nominal growth rate required for the next nine years starting from 2023-24 to 2031-32 can be derived using an assumption on exchange rate. As a starting point, we assume a fixed exchange rate of Rs. 80.36 per 1 US\$ (it is the average rate for 2022-23). The derived nominal growth rate required to achieve the target size of US\$1 trillion in 2031-32 will be 15.08% (Table 1).

Regarding the inflation rate, which is needed to derive the real growth rate, the average GDP deflator-based inflation for Karnataka was 4.7% from 2013-14 to 2022-23. However, the target inflation rate for the country estimated by the Monetary Policy Framework is 4% (Dua, 2020).⁶ Karnataka's inflation is, in general, higher than all India's inflation. Given these, we assume 4.5% annual inflation for Karnataka in the coming years. With this assumption, Karnataka's economy needs to grow at a real growth rate of 10.58% per annum for nine consecutive years from 2023-24 to 2031-32 to achieve the US\$1 trillion target. It is noted that Karnataka recorded an average real growth of 10.73% from 2004-05 to 2007-08, indicating that the state has the potential to achieve this growth rate, required to reach US\$ 1 trillion in 2031-32.

It is also observed that the growth of Karnataka economy is not independent of the growth of India (and other Indian states). When the Indian economy grew at 8.26% in 2016-17, Karnataka recorded an impressive growth rate of 13.29% (i.e., about 5 percentage points higher). When the growth of the Indian economy slowed

⁶ As per the Monetary Policy Framework Agreement between Government of India and RBI, a flexible inflation targeting in India has been adopted officially. The Central Government announced in the Official Gazette a 4% Consumer Price Index (CPI) inflation target, with upper and lower tolerance limit at 6% and 2%, respectively.

down to 3.87% (a reduction of 4.38%) in 2019-20, Karnataka's growth also declined to 5.87%, a

reduction of about 7.4 percentage points. This low growth regime is of great concern.

Table 1: Growth required to achieve a US\$ 1 trillion Karnataka economy by 2031-32 with a fixed exchange rate

Year	Nominal GSDP (Rs. Crore)	Derived Nominal Growth (%)	Real Growth Rate (%)	Exchange Rate (Rs./US\$)	Nominal GSDP (US\$ Trillion)	Population (000s)	Per Capita GSDP (Rs.)	Per Capita GSDP (US\$)
2022-23	2269995	-	-	80.36	0.28	67692	335342	4173
2023-24	2612310	15.08	10.58	80.36	0.33	68115	383515	4772
2024-25	3006247	15.08	10.58	80.36	0.37	68538	438625	5458
2025-26	3459589	15.08	10.58	80.36	0.43	68962	501666	6243
2026-27	3981295	15.08	10.58	80.36	0.50	69300	574501	7149
2027-28	4581674	15.08	10.58	80.36	0.57	69638	657927	8187
2028-29	5272590	15.08	10.58	80.36	0.66	69976	753486	9376
2029-30	6067697	15.08	10.58	80.36	0.76	70314	862943	10738
2030-31	6982706	15.08	10.58	80.36	0.87	70652	988324	12299
2031-32	8035697	15.08	10.58	80.36	1.00	70911	1133209	14102

Source: Authors' estimation.

Note: Projected population data from Report of the Technical Group on Population Projection, July 2020.

Given the fact that the average annual exchange rate movement is varying over the years, it is not wise to assume a constant exchange rate as in Table 1. Evidence indicates that the average annual depreciation of the Indian rupee against the US dollar has varied over time, with rates of 2.76% during 2003-04 to 2023-24, 4.1% during 2013-14 to 2022-23, and 1.99% during the three years just before the onset of the pandemic (2017-18 to 2019-20). To account for this variability, we assume a 2% annual depreciation of the Indian rupee against the US dollar. Holding other assumptions, the implied nominal growth rate required to reach US\$ 1 trillion economy by 2031-32 would be 17.38%, and the required real growth

rate will be 12.88%, which is a very ambitious target (Table 2).

It is noted that Karnataka economy registered a 11-year average real growth of 7.51% from 2012-13 to 2022-23, and it recorded a higher average real growth rate of 8.94% from 2020-21 to 2023-24 (i.e., after the pandemic). Given these, the required real growth rate of 12.88% does not appear feasible. That is, this scenario is ruled out.⁷ Therefore, we examine a possible (i.e., an alternative) scenario with a model-based forecasts of real growth rates in future years using past trend in the real growth of Karnataka economy from 1991-92 to 2022-23 in the next section.⁸

⁷ Under this scenario, the US\$500 billion landmark will be achieved in 2026-27 instead of 2025-26.

⁸ The data for real GSDP growth from 1991-92 to 2022-23 were compiled from the website of the Ministry of Statistics and Programme Implementation (MOSPI), Government of India.

Table 2: Growth required to achieve a US\$ 1 trillion Karnataka economy by 2031-32 with a varying exchange rate

Year	Nominal GSDP (Rs. Crore)	Derived Nominal Growth (%)	Real Growth Rate (%)	Exchange Rate (Rs./US\$)	Nominal GSDP (US\$ Trillion)	Population (000s)	Per Capita GSDP (Rs.)	Per Capita GSDP (US\$)
2022-23	2269995			80.36	0.28	67692	335342	4173
2023-24	2664566	17.38	12.88	81.97	0.33	68115	391186	4772
2024-25	3127720	17.38	12.88	83.61	0.37	68538	456348	5458
2025-26	3671381	17.38	12.88	85.28	0.43	68962	532377	6243
2026-27	4309540	17.38	12.88	86.98	0.50	69300	621867	7149
2027-28	5058624	17.38	12.88	88.72	0.57	69638	726417	8187
2028-29	5937914	17.38	12.88	90.50	0.66	69976	848564	9377
2029-30	6970043	17.38	12.88	92.31	0.76	70314	991274	10739
2030-31	8181575	17.38	12.88	94.15	0.87	70652	1158010	12299
2031-32	9603697	17.38	12.88	96.04	1.00	70911	1354331	14102

Source: As in Table 1.

3. Towards a US\$ 1 Trillion Karnataka Economy using a Model-based Forecasts of Real Growth Rate

The above (and simple) arithmetic procedure indicates that Karnataka economy needs to grow at a real growth of 12.88% till 2031-32 to achieve the target of US\$ 1 trillion economy by 2031-32. The economic survey of Karnataka (2021-22) has also showed that a compounded annual growth rate (CAGR) of 13.8% is required to achieve this target by 2031-32. Of course, there are a few other studies, analyzing a similar issue of reaching one trillion-dollar economy by some other major Indian states.⁹ For instances, Rangarajan and Shanmugam (2023) examine whether Tamil Nadu's economy will become a US \$1 trillion economy by 2030 as announced by the Chief Minister of Tamil Nadu at the Investors Conclave in July 2021 and find that, the Tamil Nadu economy needs to grow at a real growth rate of 13.2% per annum for 8 consecutive years from 2023-24 to 2030-31 to reach the US \$1 trillion target. EY (2023) estimated that the

economy of Karnataka will be US\$ 0.49 trillion by 2027-28, next to Maharashtra which will be of US\$ 0.67 trillion.

However, the projections in the above studies lack the rigor of model-based forecasting. Moreover, most of them assume constant exchange rate, highlighting the need for a comprehensive modelling approach to assess the state's economy and the feasibility of achieving the target within the specified timeframe.

3.1. Empirical Model

Since the GSDP growth rate fluctuates around a higher level and more persistent during expansions and stays at a relatively low level and less persistent during contractions, Hamilton (1989) suggests the popular Markov (regime) switching (MS) model, which characterizes the time series behaviour in different regimes. In particular, the Markov Switching Auto-Regression (MS-AR) model allows for non-linearity by introducing the possibility of shifts in the GSDP growth rate

⁹ Maharashtra and Uttar Pradesh set the target to be achieved by 2027 while Gujarat aims to reach the target by 2030.

due to unforeseen changes in macroeconomic policies. Therefore, this study uses a two-state fourth order univariate Markov regime switching

auto regression model (based on relevant statistics discussed below) to forecast the future growth rate of Karnataka economy from 2023-24.

The MS(2)-AR(4) model is specified as:

$$y_t - \mu_{st} = \phi_1(y_{t-1} - \mu_{st-1}) + \phi_2(y_{t-2} - \mu_{st-2}) + \phi_3(y_{t-3} - \mu_{st-3}) + \phi_4(y_{t-4} - \mu_{st-4}) + \epsilon_{st} \quad (1)$$

and

$$\mu_{st} = \alpha_1 s_1 + \alpha_2 s_2 \quad (2)$$

where ϵ_t is the i.i.d. normal error with mean 0 and state dependent variance (σ_{12} and σ_{22}). μ is the state dependent mean, and ϕ_p is the p^{th} AR term. y_t is the growth rate of real GSDP of Karnataka; ϕ_1, ϕ_2, ϕ_3 and ϕ_4 are the respective coefficients of AR terms; s_t being the state variable, follows the first order Markov process. It takes values 1 and 2 (i.e., $S_t=1$ if low growth state, and $S_t=2$ if high growth state). α_1 and α_2 are the average growth rate for regime one and two respectively. As the state variable follows a two-state first order Markov process, its transition probability matrix is:

$$P = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix} \quad (3)$$

where, p_{11} and p_{22} are the probability of being in regime 1, given that the system was in regime one during the previous period and the probability of being in regime two given that the system was in regime two during the period respectively. $1-p_{11}$ denotes the probability of shifting from state one to state two between periods $t-1$ and t . $1-p_{22}$ defines the probability of shifting from state two to state one between times $t-1$ and t . The model

is estimated using the maximum likelihood approach. Based on the estimation results of the MS(2)-AR(4) model, the real GSDP growth rates are predicted for future periods and are used to calculate the nominal GSDP growth by adding a 4.5% inflation rate. Then these rates are used to compute the real GSDP figures (at 2011-12 prices) and nominal GSDP figures for Karnataka in future periods.

3.2. Empirical Results

The first step is to test for the presence of unit root in the real growth of GSDP, using the Augmented Dickey-Fuller (ADF) test. The test result (-4.616 ($p=0.001$)) suggests that the series does not contain any unit root. That is, the series is stationary. The next step is to select the optimal lag order of the model using the information criteria-Akaike Info Criterion (AIC), Hannan-Quin Info Criterion (HQIC) and Swartz-Bayesian Info Criterion (SBIC). Results in Table 3 suggest that MS(2)-AR(4) is the optimal model (which is one with minimum info criteria value).

Table 3: Information criteria for model selection

Lag Selection Criteria	MS(2)-AR(1)	MS(2)-AR(2)	MS(2) AR(3)	MS(2) AR(4)
AIC	5.6273	5.6912	5.7503	4.7843*
HQIC	5.7335	5.8118	5.8848	4.9319*
SBIC	5.9479	6.0613	6.1707	5.2557*

Source: Authors' estimation.

Note: * indicates optimum lag based on minimum info criteria value.

Table 4 presents the maximum likelihood estimation results of the model, with one state for contraction (regime 1) and another one for the expansion phase (state 2). All auto-regression terms' coefficients are statistically significant at

1% level except the third term order term, which is, however, significant at 10% level. In the contractionary regime 1, the average growth rate is ($\alpha_1 =$) 6.54%. In the expansionary regime 2, the average growth rate is ($\alpha_2 =$) 8.61%.

Table 4: Maximum likelihood estimates of the Markov switching model

Variable	Coefficient	Standard Error
α_1	6.544***	0.328
σ_1	1.355***	0.201
α_2	8.612***	0.058
σ_2	-2.142***	0.290
ϕ_1	-0.137***	0.015
ϕ_2	0.341***	0.031
ϕ_3	0.050*	0.026
ϕ_4	-0.442***	0.014
p_{11}	0.50	
p_{22}	0.001	

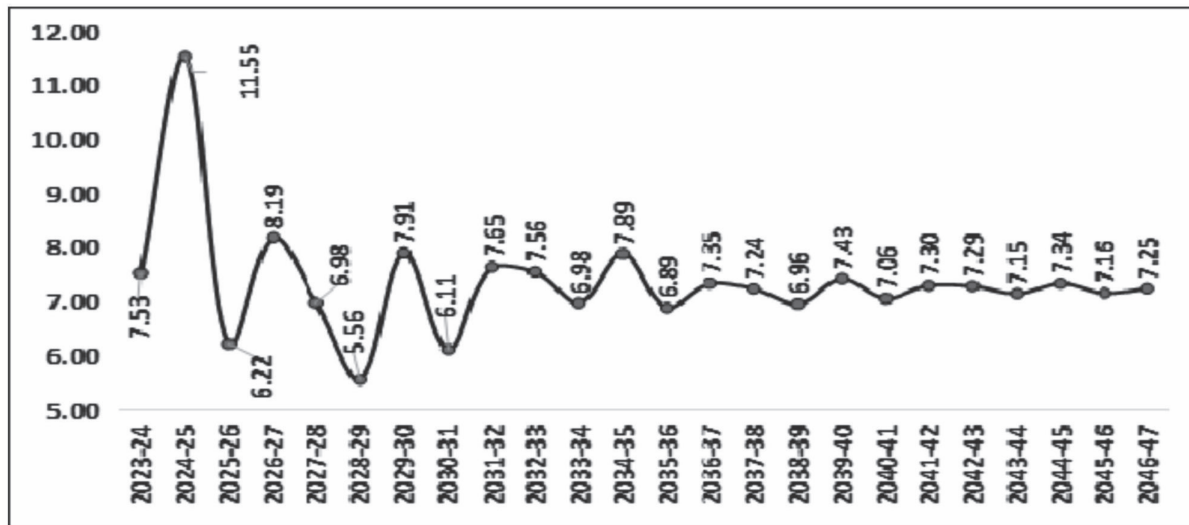
Source: Authors' estimation.

Note: *** significant at 1% level and * significant at 10% level

In Table 4, the probability that the contraction will be followed by another year of contraction is $p_{11} = 0.50$; the expected duration in state one is $1/(1-p_{11}) \approx 2$; that is, this regime will persist on average for three years. The probability that the expansion will be followed by another year of expansion is $p_{22} = (1-p_{21}) = 0.001$ and this high growth regime 2 is expected to persist for only a year. Similarly, the probability that the contraction followed by expansion is $p_{12} = 0.5$ and the probability that

the expansion will be followed by contraction is $p_{21} = 0.99$. The model-based dynamic forecast of real GSDP growth of Karnataka from 2023-24 to 2046-47 (i.e., for 24 years) shown in Figure 1 highlights the regime switching characteristics of future real growth of Karnataka economy with an average rate of 7.36%.

Figure 1: Dynamic forecast of real GDP growth of Karnataka (%)



Source: Authors' estimation.

3.3. Model-based Growth Scenario to Achieve US\$ 1 Trillion

In the most possible scenario, we use the above model-based future growth rate of real GSDP, 4.5% inflation and the exchange rate depreciation of 2% every year. Karnataka will reach the target of one trillion-dollar economy in 2036-37 and not in 2031-32 in this scenario (Table 5). The average of the forecasted growth rate based on the model from 2023-24 to 2036-37 is 7.46%. It is interesting to note that this rate is almost equal to the historical average growth of 7.51% achieved from 2012-13 to 2022-23.¹⁰

Interestingly, in 2036-37 the per capita income of Karnataka will reach slightly above US\$13,845, which is the minimum threshold required to be classified as high income by the World Bank. We have extended this feasible scenario exercise till 2046-47, the year in which India aims to become a developed economy. In 2046-47, Karnataka will become US\$ 2.58 trillion economy (about 9.1 times larger than what was it in 2022-23). It is noted that Karnataka economy in this scenario will reach US\$ 0.5 trillion only in 2028-29 (Table 5).

Table 5: Model-based growth scenario to achieve US\$ 1 trillion Karnataka economy with varying exchange rate

Year	Nominal GSDP (Rs. Crore)	Derived Nominal Growth (%)	Real Growth Rate (%)	Exchange Rate (Rs./US\$)	Nominal GSDP (US\$ Trillion)	Population (000s)	Per Capita GSDP (Rs.)	Per Capita GSDP (US\$)
2022-23	2269995			80.36	0.28	67692	335342	4173
2023-24	2543124	12.03	7.53	81.97	0.31	68115	373357	4555
2024-25	2951345	16.05	11.55	83.61	0.35	68538	430614	5150

¹⁰ When we simplify the average rate of 7.5% every year in Table 5, we get the similar result that Karnataka will reach the target of one trillion-dollar economy in 2036-37.

Year	Nominal GSDP (Rs. Crore)	Derived Nominal Growth (%)	Real Growth Rate (%)	Exchange Rate (Rs./US\$)	Nominal GSDP (US\$ Trillion)	Population (000s)	Per Capita GSDP (Rs.)	Per Capita GSDP (US\$)
2025-26	3267660	10.72	6.22	85.28	0.38	68962	473835	5556
2026-27	3682476	12.69	8.19	86.98	0.42	69300	531382	6109
2027-28	4105338	11.48	6.98	88.72	0.46	69638	589526	6644
2028-29	4518420	10.06	5.56	90.50	0.50	69976	645710	7135
2029-30	5079074	12.41	7.91	92.31	0.55	70314	722342	7825
2030-31	5618157	10.61	6.11	94.15	0.60	70652	795187	8446
2031-32	6300785	12.15	7.65	96.04	0.66	70911	888548	9252
2032-33	7060633	12.06	7.56	97.96	0.72	71170	992080	10128
2033-34	7870928	11.48	6.98	99.92	0.79	71429	1101923	11028
2034-35	8846257	12.39	7.89	101.92	0.87	71689	1233977	12108
2035-36	9853453	11.39	6.89	103.95	0.95	71948	1369524	13174
2036-37	11020661	11.85	7.35	106.03	1.04	72268	1524961	14382

Source: Authors' estimation.

3.4. Alternative (but Feasible) Scenarios

It is noted that the above model-based forecasts are based on past data. Someone may argue that the long-term time series model forecasts based on past data model may not be reliable. Adoption of future technological advancements (i.e., artificial intelligence etc.) and initiatives of the government's growth induced policies will lead to higher growths in future (of course, unforeseen negative shocks will lead to low growth). Therefore, we consider two alternative (feasible) scenarios: (i) in scenario 1, the projected growth rate from the MS-AR model in every future year will increase by 1%, and (ii) in scenario 2, it will increase by 2%. In the alternative scenario 1, Karnataka will reach the one trillion-dollar economy (and developed economy) status in 2035-36 (not shown).¹¹ In Scenario 2, the state will achieve the target of one trillion-dollar economy (and developed economy) status in 2034-35. These two scenarios may also be considered as possible scenarios.

We now examine the possibility of raising the real growth to the 8.5% and above (9.5%) in the subsequent sections.

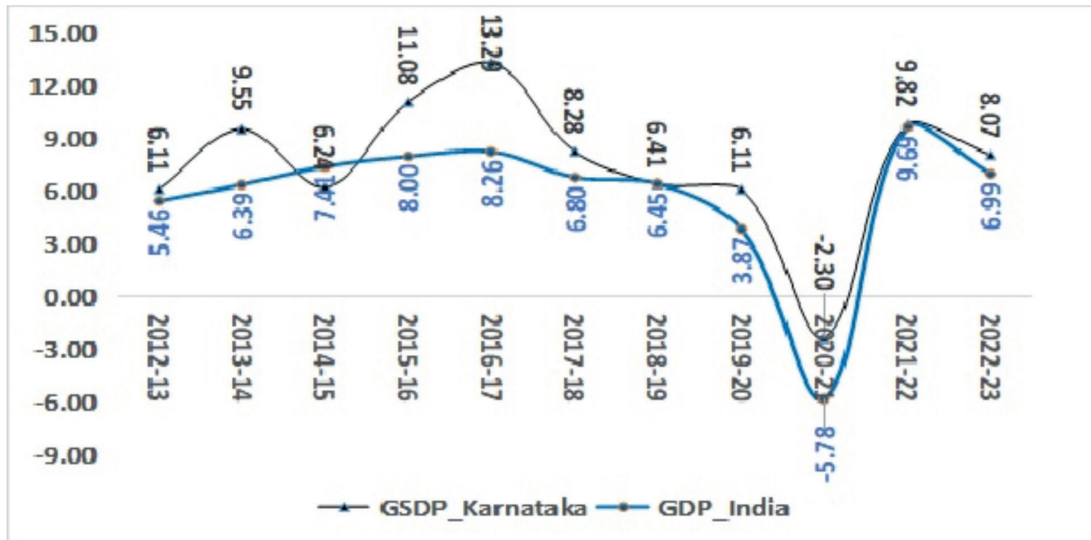
4. Strategies to Achieve the Targets

4.1. Growth Profile of Karnataka Economy

Karnataka registered a real growth performance of 7.91% as against all India growth of 8.23% from 2005-06 to 2011-12 (not shown). Its average growth declined to 7.51% as against all India growth of 5.77% from 2012-13 to 2022-23 (Figure 2). Karnataka's growth pattern is more volatile than India's growth path. Given the current average growth rate, it is a tough task to achieve 9.5%. However, there is a hope to reach around 8.5% as in the last two years' average growth rate of Karnataka is 8.94% (which includes higher growth in 2021-22 due to low base effect). In such case, the target of US\$ 1 trillion economy is expected to reach only at or after 2035-36.

¹¹ The results are available with the authors on request.

Figure 2: Economic Growth (%): Karnataka and India



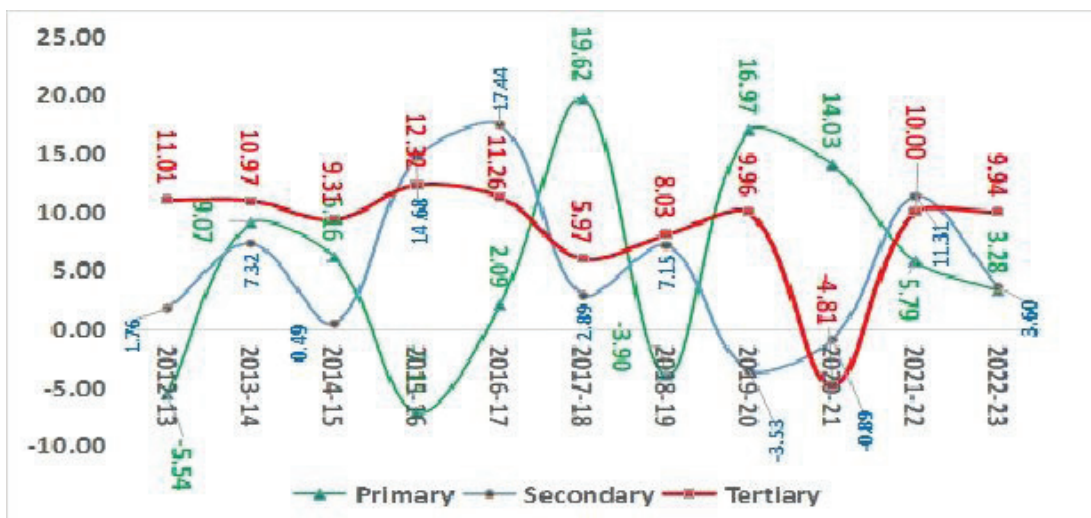
Source: Authors' calculation based on basic data from MOSPI.

4.2. Growth Pattern of Three Broad Subsectors

The sectoral growth pattern in Figure 3 shows that during 2012-13 to 2022-23, the primary sector grew at an average rate of 5.49%, the secondary sector at 5.66% and the tertiary sector at 8.54%. The growth paths of both primary and secondary sectors are more volatile than the services growth

path. The high volatility in both primary and secondary sectors implies that the risk-adjusted returns from them are low and so they may find it difficult to attract private investments. Therefore, efforts are needed to make faster and stable growth of these sectors.

Figure 3: Sectoral Growth in Karnataka (%)



Source: As in Figure 2.

4.3. Structure of GSDP

Karnataka's GSDP is driven by tertiary sector with about 56% (average) share in the total GSDP. The secondary sector contributes about 24% and

the primary sector about 11%. (Table 6). There is a possibility for Karnataka to increase its GSDP by increasing growth of both secondary and primary sectors.

Table 6: Share of GSDP (%) in Karnataka (at 2011-12 prices)

Sectors	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Average
Primary	13.21	11.76	11.71	11.70	9.78	8.82	9.74	8.79	9.70	11.31	10.90	10.42	10.65
Secondary	26.12	25.05	24.54	23.21	23.97	24.85	23.61	23.78	21.62	21.93	22.23	21.31	23.52
Tertiary	51.79	54.18	54.88	56.47	57.11	56.08	54.89	55.72	57.74	56.26	56.35	57.33	55.73
Taxes minus subsidies on Products	8.88	9.01	8.87	8.62	9.14	10.25	11.76	11.71	10.94	10.50	10.53	10.95	10.10
GSDP	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: As in Figure 2.

Deloitte (2024) emphasizes the importance of prioritizing 12 key sectors including aerospace and defence, agriculture and food processing, automobiles and auto ancillaries, capital goods, clean energy, construction, education, IT/ITES, electronics, pharmaceuticals and biotech, start-ups, textiles and garments, and tourism for Karnataka to achieve its goal of becoming a US\$1 trillion economy. The economic survey of Karnataka (2021-22) outlined a 13-point plan, emphasizing investments in specialized hi-tech industries like biotechnology, semiconductors, electronics component design, and materials innovation to support higher growth. These suggestions would be highly useful for Karnataka to reach the target in around 2035-36.

5. Fiscal Issues

Investments (public and private) are essential ingredients for higher growth. In fact, the growth is determined by the investment rate and the efficiency in the use of capital. According to the Harrod-Domar equation, the growth rate is equal

to the investment rate divided by the incremental capital-output ratio (Rangarajan, 2017). The incremental capital-output ratio (ICOR) is the additional unit of capital required to produce an additional unit of output. The higher the ICOR, the less efficient we are in the use of capital. For India, the incremental capital-output ratio which is commonly used as 4-4.5. Since Karnataka needs to grow at a real growth rate of 9.5% per annum to reach the target of US\$ 1 trillion economy in 2034-35, with ICOR of 4 (4.5) the investment rate in Karnataka needs to be around 38% (42.8%) of GSDP from 2023-24.

Since the data on private investments are unavailable, we look at the fiscal space available for public investments. But the government finances of Karnataka are under stress in recent years. Particularly, it suffers from its unsustainable level of outstanding liabilities. Economic policymakers often rely on debt accumulation as a strategy to fuel higher growth when current revenues fall short of meeting escalating spending and investment needs. This approach hinges on two primary theories: the

Keynesian theorem and the neo-classical theorem. According to Keynesian economics, deficit financing can stimulate aggregate demand, thereby fostering economic expansion. Conversely, the neo-classical perspective posits that a mounting deficit signifies higher government dissavings, potentially posing risks to economic growth. Empirical studies have found that maintaining debt levels beyond the sustainable threshold level is detrimental to economic growth (Ghosh et. al 2013; Shanmugam and Shanmugam 2023).

Shanmugam and Renjith (2023) estimated the sustainable level of debt threshold of Karnataka at 20.03 per cent of GSDP. Based on the standard debt dynamic formula,¹² which factors in the previous year's debt-GSDP ratio (d_{t-1}), current fiscal deficit (f_t), and nominal growth rate (g_t), we've conducted an estimation of Karnataka's debt-to-GSDP ratio from 2025-26 onwards.¹³ This analysis aims to ascertain whether Karnataka's debt will reach a sustainable level and, if so, when. Our examination involves various scenarios,

considering different fiscal deficit targets (2% or 3%) and growth rates (12%, or 13% or 14%).

Simulation results show that if a 2% fiscal deficit is maintained along with a 12% nominal GSDP growth, then the debt-to-GSDP ratio will decline from the current level of 23.7% (2024-25 BE) to 23.14% in 2025-26 and will fall below the sustainable level of 20.03% by 2036-37 (Table 7). If additional growth by 1% (i.e. the nominal growth of 13%) every year can be achieved, then the debt ratio can be brought to a sustainable level by 2032-33. With 14% nominal growth rate and 2% fiscal deficit, the sustainable level will be reached in 2030-31. Thus, ensuring a 12 (or 14 per cent) nominal growth of the economy and containing its fiscal deficit to only 2% level will enable the state to reach the sustainable threshold debt level of about 20% by 2036-37 (or 2030-31). Below the threshold, the debt level will be growth inducing which is necessary to achieve the US\$1 trillion economy target.

Table 7: Debt-GSDP levels under various growth and fiscal deficit scenarios

Years	Debt -GSDP (%) with		
	12 % growth and 2 % fiscal deficit	13 % growth and 2 % fiscal deficit	14 % growth and 2 % fiscal deficit
2023-24 RE	23.24	23.24	23.24
2024-25 BE	23.68	23.68	23.68
2025-26	23.14	22.95	22.77
2026-27	22.66	22.31	21.97
2027-28	22.23	21.75	21.27
2028-29	21.85	21.24	20.66
2029-30	21.51	20.80	20.12
2030-31	21.20	20.41	19.65
2031-32	20.93	20.06	19.24
2032-33	20.69	19.75	18.88

¹² $dt = ft + (dt-1) * (1/(1+gt))$.

¹³ We have used the revised and the budget estimates for 2023-24 and 2024-25 respectively.

Years	Debt -GSDP (%) with		
	12 % growth and 2 % fiscal deficit	13 % growth and 2 % fiscal deficit	14 % growth and 2 % fiscal deficit
2033-34	20.47	19.48	18.56
2034-35	20.28	19.24	18.28
2035-36	20.11	19.02	18.03
2036-37	19.95	18.84	17.82

Source: The Authors Calculation.

If the state is unable to bring down its fiscal deficit to 2% level, but maintain at 3% level (as per the FRBM norm), the simulation results indicate that even with 14% nominal growth every year (i.e., 9.5% real growth), the debt to GSDP ratio will be above the threshold level and will stabilize at only 24.4% till 2050-51 (not shown). This means that the state cannot attain the threshold level of debt even after 2050-51. Hence, to maintain debt below the sustainable threshold level, it is essential to ensure that the fiscal deficit remains below 2 per cent, even if the economy maintains a nominal growth rate of 14 per cent. The estimates are in line with Shanmugam and Renjith (2023).

6. Conclusion and Policy Implications

The analyses above indicate that Karnataka can achieve the USD 1 trillion milestone by 2031-32 if it maintains an average nominal GDP growth of 17.38% from 2023-24 onwards (with 2% annual exchange rate depreciation). Achieving 12.88% real growth every year till 2031-32 is challenging. Our model-based forecasts of the real GDP growth of Karnataka suggest that the average real growth from 2023-24 to 2036-37 is 7.46%, which is closer to the historical average growth of 7.51% from 2012-13 to 2022-23. With this model-based forecast of growth rate, Karnataka can reach the target of one trillion-dollar economy in 2036-37.

We have also considered two alternative scenarios with the projected growth rate in every future year increases by 1%, and by 2% respectively. That is, the average growth rate at 8.5% and 9.5% respectively. In scenario 1, Karnataka can reach the one trillion-dollar economy in 2035-36 and in Scenario 2, the target in 2034-35. These two scenarios may also be considered as possible scenarios.

But scenario 2 requires that Karnataka needs to grow at the nominal growth of 14% every year from 2023-24 onwards. The Karnataka government needs to make effort to attain a faster and stable growth of both primary and secondary sectors. The suggestions given in Deloitte (2024) and the economic survey of Karnataka (2021-22) may be useful to achieve the faster growth/target. The government has also taken various initiatives. It has launched the new IT policy 2020-25, which prioritizes expanding IT activities beyond Bengaluru to enhance the service sector's contribution. Additionally, the "One District-One Product" initiative, part of the Atmanirbhar scheme, aims to substantially increase the agricultural GSDP. It is noteworthy that the new industrial policy 2020-25 outlines various initiatives aimed at fostering the growth and development of industries. Among these initiatives is the ambitious goal of generating 2 million new jobs within the upcoming five years (Government of Karnataka, 2020).

Karnataka also needs to ensure the investment rate at 38% -42.8% of GSDP to grow at a real growth rate of 9.5% per annum to reach the target of US\$ 1 trillion economy in 2034-35. While debt financing can be used for fueling the growth engine, it is essential to keep the fiscal balance at check in order to avoid adverse effect on growth. If the fiscal deficit is 3%, even with a 14% nominal growth, the state cannot reach the sustainable threshold levels of debt. Ensuring a 12% nominal (i.e., 7.5% real) growth of the economy and containing its fiscal deficit to only 2% level may enable the state to reach the sustainable threshold debt level by 2036-37. With 14% nominal growth and 2% fiscal deficit, the state can reach the sustainable threshold level of debt (which will be growth inducing) by 2030-31. To bring down the fiscal deficit, the appropriate policy strategy is revenue augmentation or containing government expenditures on unproductive subsidies or both. The sustained debt level may reduce interest payments and improve the state's fiscal status as this savings can be spent on growth inducing investments. This may in turn induce further growth. Thus, addressing the challenges to high growth is crucial for the timely achievement of the coveted mark of US\$ 1 trillion Karnataka economy.

Achieving one trillion-dollar economy holds a profound significance for Karnataka, representing a substantial economic transformation with wide-ranging implications. Importantly, reaching a US\$1 trillion economy would elevate the state to the minimum per capita income level of a high-income country (a minimum of US\$13,845 per capita as set by World Bank, 2023). Karnataka's achievement would also help India to achieve its ambitious goal of becoming a developed country by 2047.

References

Deloitte. 2024. Karnataka: Powering India's Growth. <https://www2.deloitte.com/content/dam/Deloitte/in/Documents/about-deloitte/in-ad-india-karnataka-investment-destination-noexp.pdf>

Dua, P. 2020. Monetary policy framework in India. *Indian Economic Review*, 55(1), 117-154.

Economic Survey of Karnataka. 2021-22. Planning, Programme Monitoring & Statistics Department. Government of Karnataka. 2022. Bangalore, Government Press. <https://planning.karnataka.gov.in/info-4/Reports/Economic+Survey+2021-22/en>

EY. 2023. Economy Watch, March 2023. Ernest and Young. https://assets.ey.com/content/dam/ey-sites/ey-com/en_in/topics/tax/economy-watch/2023/03/ey-economy-watch-march-2023.pdf

Ghosh, A.R., Kim, J.I., Mendoza, E.G., Jonathan D. O., and Mahvash S. Q. 2013. Fiscal Fatigue, Fiscal Space and Debt Sustainability in Advanced Economies. NBER Working paper (16782).

Government of Karnataka. 2020. New Industrial Policy 2020-25. Commerce & Industries Department, Government of Karnataka. <https://industries.karnataka.gov.in/storage/pdf-files/Industry%20Policy%202020-25%20English.pdf>

Hamilton, J. D. 1989. A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica: Journal of the Econometric Society*, 57(2), 357-384.

Ind-Ra. 2024. Arth Samvaad. India Ratings and Research (Ind-Ra). February 2024. <https://www.indiaratings.co.in/pressrelease/69399>.

Niti Aayog. 2022. Export Preparedness Index-2022, Niti Aayog. https://www.niti.gov.in/sites/default/files/2023-07/Export-Preparedness-Index-2022_0.pdf

Rangarajan, C. 2017. Sharpen the Focus on Growth, *The Hindu*, April 03. (<https://www.thehindu.com/opinion/lead/sharpen-the-focus-on-growth/article17763234.ece>).

Rangarajan, C., & Shanmugam, K. R. 2023. Achieving One Trillion Dollar Economy for Tamil Nadu: Some Implications and Concerns. *Indian Public Policy Review*, 4(1 (Jan-Feb)), 1-26.

Shanmugam, K. R., & Renjith, P. S. 2023. Sustainability and Threshold Value of Public Debt: Evidence and Implications for Karnataka. *Aarthika Charche*, 8(2), 5-17.

Shanmugam, K.R. and Shanmugam, K. 2023: Sustainability and Threshold Value of Public Debt in Tamil Nadu, *Economic and Political Weekly*, 58(14), 38-45.

World Bank. 2023. World Bank group country classifications by income level for FY24. World Bank. <https://blogs.worldbank.org/en/opendata/new-world-bank-group-country-classifications-income-level-fy24>

Sustainability of Fiscal Policy in India: Evidence and Implications from National and State Level Analyses

Duragesh Pujari¹, Shreya Suppannavar² and R.R. Biradar³

Abstract

The study examines the sustainability of fiscal policies at the central and state levels in India. States are classified based on their Human Development Index (HDI) value in 2021. To assess fiscal policy sustainability, the study employs the PP unit root test and co-integration test, categorizing the period into pre-FRBM and post-FRBM Act phases. The analysis reveals significant variations in fiscal sustainability across states and periods, influenced by regional economic factors and policy frameworks. While the central government achieved sustainability in post-FRBM period, many state governments struggled, particularly compared to the pre-FRBM period. Highly developed states initially demonstrated sustainability but faced challenges post-FRBM Act. Variations within developed, moderately developed, and low-developed states are observed, indicating a need for tailored policy interventions. Karnataka, as the pioneering state in India to implement fiscal reforms, aimed to improve fiscal health and fiscal discipline by balancing expenditure and revenue. Despite these efforts, Karnataka has consistently shown fiscal unsustainability across the pre-FRBM Act, post-FRBM Act, and overall periods. This underscores the urgent need for Karnataka to strengthen fiscal management strategies. Key areas of focus may include enhancing revenue generation, rationalizing expenditures, and adhering to fiscal responsibility frameworks to ensure long-term fiscal sustainability.

JEL Classification Codes: H2, H3, C1

1. Introduction

Fiscal discipline involves maintaining control over budgetary allocations by establishing enforceable expenditure limits at both the overall and individual spending entity levels. A well-functioning budget system is characterized by its ability to enforce strict limits (as opposed to accommodating them). The primary objective of a budget system is to exercise control over total expenditures. The existence of a budget is justified by the necessity to prevent unchecked increases in totals to meet all demands (ADBI, 1999; Allen and Tommasi, 2001). Fiscal discipline requires that governments maintain fiscal positions that

are consistent with macroeconomic stability and sustained economic growth (Kumar and Ter-Minassian, 2007).

Government debt management involves formulating and executing a strategy to prudently handle public debt, addressing the government's funding requirements while achieving cost and risk objectives. This process also aims to establish and uphold an efficient market for government securities (Wheeler, 2004). The primary goal of public debt management is to meet the government's financing needs and payment obligations at the most economical cost over the medium to long term while maintaining

¹ Research Scholar, Department of Economics, Karnatak University, Dharwad-580003. E-mail: pkduragesh@gmail.com

² Assistant Professor, Amity Business School, Amity, Bengaluru-560034.

³ Professor, Department of Economics, Karnatak University Dharwad-580003.

a judicious level of risk (IMF and World Bank, 2001). According to a 2000 survey among members of the Organization for Economic Cooperation and Development (Kappagoda, 2001), debt management policies have four general objectives: ensuring government financing needs, minimizing borrowing costs, keeping risks at an acceptable level, and supporting the development of domestic markets. The overarching aim of public debt management should be to fulfill the financial needs of public sector at the lowest possible cost while maintaining an acceptable risk level over a medium or long term. Effective debt management plays a crucial role in maintaining debt sustainability, alongside enhancing analytical instruments for assessing such sustainability. The term “debt sustainability” denotes a government’s capacity to fulfill its present and upcoming debt responsibilities without compromising its fiscal and economic stability.

Karnataka is the first state in India to implement fiscal policy reforms aimed at improving fiscal health and discipline, achieving an ideal balance between expenditure and revenue. Fiscal health encompasses expenditure, revenue, deficit, and debt levels. Good fiscal health is essential for sustainable fiscal policy. This study includes Karnataka to compare with other states and determine if it has achieved fiscal policy sustainability following the introduction of the FRBM Act. Data on revenue, expenditure, and GSDP have been collected from the RBI. Fiscal policy sustainability is crucial for Karnataka as it ensures long-term economic stability, efficient resource allocation, and reduced fiscal deficits and debt. This fosters investor confidence, promotes growth, and enhances the state’s ability to fund development projects, ultimately improving public welfare and economic resilience.

2. Methodology

2.1. Framework for empirical analysis

Based on theoretical background in Annexure-1, the evaluation of fiscal policy

sustainability can be succinctly summarized through a graphical sequential overview, as depicted in Figure 1.

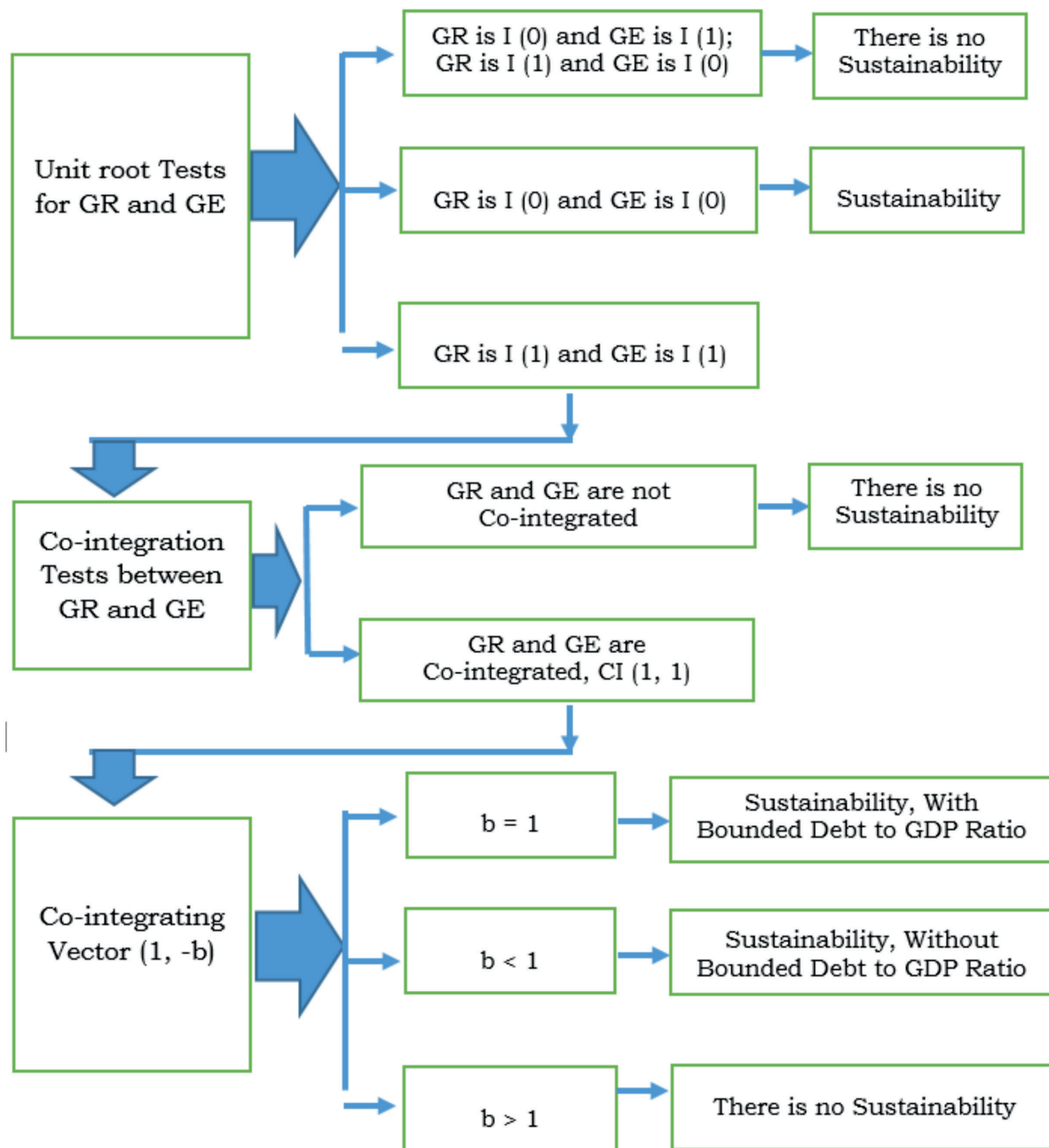
The unit root test is employed to determine the stationarity of time series data, specifically revenues and expenditures in fiscal policy sustainability analysis. Stationarity is crucial because non-stationary data can lead to spurious regression results, making it difficult to draw reliable conclusions about the relationship between variables over time. If both revenues and expenditures are stationary at level $I(0)$, it means their series do not exhibit a unit root in levels. This suggests that they are already stable over time and do not require differencing to achieve stationarity. In this case, fiscal policy is considered sustainable because revenues and expenditures evolve in a manner that is conducive to long-term fiscal stability without excessive reliance on debt accumulation. If revenues and expenditures are stationary at first differences $I(1)$, it indicates that their series contain a unit root in levels but become stationary after differencing once. This situation suggests a short-term deviation from equilibrium that adjusts over time.

Co-integration examines whether there exists a stable long-run relationship between revenues and expenditures. If the co-integration test shows a coefficient (denoted as ‘ b ’ in the vector $(1, -b)$) less than 1, it indicates that revenues and expenditures tend to converge in the long run but with revenues growing slightly faster than expenditures relative to GDP. This scenario supports sustainable fiscal policies as long as the debt-to-GDP ratio remains manageable and does not escalate beyond sustainable levels. Conversely, if the coefficient ‘ b ’ in the co-integration vector exceeds 1, it suggests that expenditures grow faster than revenues over time. This situation can lead to fiscal unsustainability as the debt-to-GDP ratio may increase uncontrollably, potentially straining government finances and economic stability. Co-integration with a coefficient of 1, suggesting that

revenues and expenditures grow in tandem over time. Fiscal policy is sustainable with a bounded

debt-to-GDP ratio, as the government can cover its expenditures without excessive reliance on debt.

Figure 1: Fiscal Policy Sustainability, Unit Root and Co-integration Tests



Source: António Afonso (2004).

Note: GR Government Revenue; GE Government Expenditure; Even if there is no Co-integration, sustainability might not be a problem if, for instance, Revenues are higher than Expenditure.

2.2. Data

This study employs a time series data at the central and state levels in India. Data on revenue and expenditure, GDP and GSDP are collected from the Reserve Bank of India (RBI) for the period from 1970 to 2022 for the central and combined state governments. The data are adjusted using the GDP deflator and presented in real terms. For the analysis of each state, RBI data from 1990 to 2022 is used. The study excludes Union Territories (UTs) and Telangana state due to insufficient data availability. States are classified as per HDI value in 2021 with state-specific HDI data sourced from Global DataLab. To assess fiscal policy sustainability, the study applied the PP unit root test and co-integration test as analytical tools (Annexure 1). The period is categorized into two significant phases for both the central and state levels: pre-FRBM (before 2003-04) and post-FRBM Act (after 2004-05). For each state, the categorization into pre- and post-FRBM Act phases is based on the introduction of Fiscal Responsibility Legislation (as detailed in Annexure 2).

3. Empirical results

3.1. Unit root test

Fiscal sustainability in central, Combined State governments and individual states are estimated by assessing the presence of co-integration between government expenditures and revenues, expressed as a percentage of GDP. The initial phase involves evaluating the presence of a unit root for government expenditures and revenues expressed as a percentage of GDP, aiming to ascertain whether they are most appropriately classified as I (0) or I (1) series. The outcomes of these tests for the series in levels are presented in **Table.1**.

The PP (Phillips-Perron) unit root test is a statistical method used to determine the stationarity of a time series data. Stationarity implies that the statistical properties of a time series, such as its mean and variance, do not change over time. Thus, we examine the stationarity of the first differences of these series. The PP test indicates that all series are non-stationary at the level during both the pre and post-FRBM-Act periods, as well as the total period in India. As per the results presented in Table 1, there is a general tendency not to reject the stationarity of the first differences for government expenditures and revenues throughout the aforementioned periods. This finding holds for all series about both central and combined state governments, as indicated by the PP test.

Table 1: Unit Root Test for Government Revenue and Expenditure: 1970-2022

Period	Variables	At Level		First Difference		Further rocess
		With Constant t-Stat	With Constant & Trend t-Stat	With Constant t-Stat	With Constant & Trend t-Stat	
Central Government						
Pre-FRBM Act	CTR/GDP	-0.255	-2.839	-7.470***	-7.343***	Co-integration
	CTE/GDP	-0.151	-2.859	-7.489***	-7.544***	
Post-FRBM Act	CTR/GDP	-1.705	-1.921	-4.067***	-3.987**	Co-integration
	CTE/GDP	-1.726	-1.882	-3.771**	-3.549*	
Total Period	CTR/GDP	-0.255	-2.839	-7.470***	-7.343***	Co-integration
	CTE/GDP	-0.151	-2.859	-7.489***	-7.544***	

Period	Variables	At Level		First Difference		Further rocess
		With Constant t-Stat	With Constant & Trend t-Stat	With Constant t-Stat	With Constant & Trend t-Stat	
State Governments						
Pre-FRBM Act	STR/GDP	0.5662	-2.335	-7.465***	-8.603***	Co-integration
	STE/GDP	-0.989	-2.122	-6.039***	-6.032***	
Post-FRBM Act	STR/GDP	-1.254	-1.908	-3.712**	-3.666*	Co-integration
	STE/GDP	-0.328	-1.777	-2.587	-4.828***	
Total Period	STR/GDP	0.566	-2.335	-7.465***	-8.603***	Co-integration
	STE/GDP	-0.989	-2.122	-6.039***	-6.032***	

Source: Authors.

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Lag Length based on AIC.

Probability based on MacKinnon (1996) one-sided p-values.

CTR Central Total Revenue; STR States Total Revenue; CTE Central Total Expenditure; STE States Total Expenditure.

3.2. Co-integration results

Following the PP test, Co-integration analyses are conducted using the Granger (1969) Engle and Granger (1987), and Johansen (1988, 1991) tests on government revenues and expenditures expressed as a percentage of GDP. These tests are

conducted separately for central and combined state governments, given that the PP test statistic indicates the rejection of the null hypothesis of a unit root for the first difference of the revenue and expenditure series. The results of the co-integration tests are presented in **Table 2**.

Table 2: Co-integration test for Fiscal Policy Sustainability: 1970-2022

Period	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
Central Government						
Pre-FRBM Act	CTR/GDP	[1 -0.194]	0.571	[1 7.096]***	0.004	Unsustainable
	CTE/GDP	[1 -0.194]	0.568	[1 0.141]***		
Post-FRBM Act	CTR/GDP	[1 -0.803]*	0.088	[1 -1.208]**	0.031	Sustainable
	CTE/GDP	[1 -0.801]*	0.088	[1 -0.828]**		
Total Period	CTR/GDP	[1 -0.314]	0.126	[1 -1.349]	0.717	Unsustainable
	CTE/GDP	[1 -0.310]	0.129	[1 -0.742]		

Period	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
State Governments						
Pre-FRBM Act	CTR/GDP	[1 -0.194]	0.571	[1 7.096]***	0.004	Sustainable
	CTE/GDP	[1 -0.194]	0.568	[1 0.141]***		
Post-FRBM Act	CTR/GDP	[1 -0.803]*	0.088	[1 -1.208]**	0.031	Unsustainable
	CTE/GDP	[1 -0.801]*	0.088	[1 -0.828]**		
Total Period	CTR/GDP	[1 -0.314]	0.126	[1 -1.349]	0.717	Sustainable
	CTE/GDP	[1 -0.310]	0.129	[1 -0.742]		

Source: Authors.

Note: *, ** and *** significant at 10%, 5% and 1%, respectively.

CTR Central Total Revenue; STR States Total Revenue; CTE Central Total Expenditure; STE States Total Expenditure.

The results in Table 2 indicate the rejection of the co-integration hypothesis (no co-integration) for the central government during both the pre and post-FRBM-Act periods, except for the total period. In the analysis of combined state governments, the co-integration hypothesis is rejected for the pre-FRBM Act period, post-FRBM-Act period, and the total period. Notably, the estimated coefficients for expenditures in the co-integration equations, with government revenues as the dependent variable, consistently remain below one.

For instance, during the central government's post-FRBM-Act period, a one percentage point increase in public expenditures results in 1.20 percentage point increase in public revenues as per the co-integration equations. This suggests that during this period, the central government achieved sustainability in fiscal policy. Conversely, in the pre-FRBM-Act period and the total period, where an insignificant co-integration vector is found, the central government did not attain fiscal policy sustainability.

In the analysis of combined state governments, a significant co-integration vector is identified in the pre-FRBM-Act period and the total period,

indicating that sustainability in fiscal policy is achieved during these periods. Specifically, in the pre-FRBM-Act period and the total period, public revenues increased by 0.471 and 3.976 percentage points of GDP, respectively. It is noteworthy that total period exhibits the highest absolute value of the estimated coefficient "b" in co-integrating vector (1, -b). In other periods with a significant co-integration vector, the absolute value of "b" is even lower.

3.3. Fiscal policy sustainability in Indian states

The PP test reveals that, over the entire period, Chhattisgarh, Kerala, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Sikkim, and Tamil Nadu states display an unsustainable fiscal policy characterized by a mixed order of Integration I (0), I (1), and I(2). But Jammu & Kashmir state has a sustainable fiscal policy in this (integrated order I (0)). All series of Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Himachal Pradesh, Haryana, Jharkhand, Karnataka, Maharashtra, Manipur, Madhya Pradesh, Rajasthan, Tripura, Uttarakhand, Uttar Pradesh, and West Bengal states are integrated at order of first difference I(1). The results are presented in **Table 3**.

Table 3: Unit Root Test for Fiscal Policy Sustainability in Indian States: 1990-91 to 2022-23

States	Variables	At Level	First Difference	Results
AP	R/GSDP	-2.582	-6.197***	Co-integration
	E/GSDP	-1.956	-5.175***	
AR	R/GSDP	-2.040	-10.738***	Co-integration
	E/GSDP	-3.023	-10.235***	
AS	R/GSDP	-1.438	-6.493***	Co-integration
	E/GSDP	-1.655	-3.716**	
BR	R/GSDP	-2.875	-16.619***	Co-integration
	E/GSDP	-2.069	-4.818***	
CG	R/GSDP	-1.328	-2.601	Unsustainable
	E/GSDP	-2.455	-6.162***	
GA	R/GSDP	-2.418	-5.305***	Co-integration
	E/GSDP	-1.968	-7.427***	
GJ	R/GSDP	-2.658	-11.639***	Co-integration
	E/GSDP	-2.400	-5.990***	
HP	R/GSDP	-2.709	-6.032***	Co-integration
	E/GSDP	-2.350	-7.082***	
HR	R/GSDP	-1.831	-26.661***	Co-integration
	E/GSDP	-2.610	-5.870***	
JK	R/GSDP	-3.555*	-19.086***	Sustainable
	E/GSDP	-4.101**	-14.822***	
JH	R/GSDP	-2.195	-5.944***	Co-integration
	E/GSDP	-3.198	-15.804***	
KA	R/GSDP	-2.881	-6.091***	Co-integration
	E/GSDP	-2.793	-7.497***	
KL	R/GSDP	-2.669	-5.471***	Unsustainable
	E/GSDP	-3.412*	-12.221***	
ML	R/GSDP	-1.591	-5.691***	Unsustainable
	E/GSDP	-4.877***	-12.889***	
MH	R/GSDP	-2.387	-7.275***	Co-integration
	E/GSDP	-2.608	-6.289***	
MN	R/GSDP	-1.786	-6.001***	Co-integration
	E/GSDP	-1.808	-4.222**	
MP	R/GSDP	-2.735	-8.620***	Co-integration
	E/GSDP	-2.569	-5.834***	
MZ	R/GSDP	-6.806***	-7.297***	Unsustainable
	E/GSDP	-3.036	-7.667***	
NL	R/GSDP	-2.662	-7.799***	Unsustainable
	E/GSDP	-3.226*	-8.844***	
OR	R/GSDP	-3.919**	-7.643***	Unsustainable
	E/GSDP	-2.325	-6.889***	
PB	R/GSDP	-2.826	-8.921***	Unsustainable
	E/GSDP	-4.053**	-9.054***	

States	Variables	At Level	First Difference	Results
RJ	R/GSDP	-2.059	-8.792***	Co-integration
	E/GSDP	-2.255	-6.152***	
SK	R/GSDP	-3.754**	-7.454***	Unsustainable
	E/GSDP	-2.671	-9.377***	
TN	R/GSDP	-5.452***	-10.284***	Unsustainable
	E/GSDP	-1.985	-6.465***	
TR	R/GSDP	-1.996	-5.089***	Co-integration
	E/GSDP	-0.750	-3.808**	
UK	R/GSDP	-2.061	-5.257***	Co-integration
	E/GSDP	-1.437	-7.326***	
UP	R/GSDP	-2.327	-8.532***	Co-integration
	E/GSDP	-2.004	-7.086***	
WB	R/GSDP	-2.783	-5.569***	Co-integration
	E/GSDP	-3.167	-7.638***	

Source: Authors.

Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Lag Length based on AIC.

Probability based on MacKinnon (1996) one-sided p-values.

R Total Revenue; E Total Expenditure.

Expenditure not included interest payment and debt services.

AP-Andhra Pradesh; AR-Arunachal Pradesh; AS-Assam; BR-Bihar; CG-Chhattisgarh; GA-Goa; GJ-Gujarat; HP-Himachal Pradesh; HR-Haryana, JK-Jammu & Kashmir; JH-Jharkhand; KA-Karnataka; KL-Kerala; ML-Meghalaya; MH-Maharashtra; MN-Manipur; MP-Madhya Pradesh; MZ-Mizoram; NL-Nagaland; OR-Orissa; PB-Punjab; RJ-Rajasthan; SK-Sikkim; TN-Tamil Nadu; TR-Tripura; UK-Uttarakhand; UP-Uttar Pradesh and WB-West Bengal.

The results of the co-integration tests reveal that, except for Jharkhand, Tripura, and Uttarakhand states, the hypothesis of no co-integration is rejected for all states during the total period. In the light of these findings, it can be inferred that Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Himachal Pradesh, Haryana, Karnataka, Maharashtra, Manipur, Madhya Pradesh, Rajasthan, Uttar Pradesh, and West Bengal have achieved sustainability in fiscal policy over the entire period. Specifically, Gujarat, Goa, Andhra Pradesh, and West Bengal, have increased their public revenues by 0.207, 0.168, 0.136, and 0.135 percentage points of GDP, respectively. It is noteworthy that these four states exhibit the higher absolute values of the estimated coefficient 'b' in the co-integrating vector (1,

-b). For the other states where a significant co-integration vector is identified, 'b' has an even lower absolute value. The results are presented in **Table 4**.

The PP test results in **Table 5** shows that, over the pre-FRBM-Act period, Orissa state display an unsustainable fiscal policy characterized by a mixed order of Integration I(0) and I(1). Haryana and Tamil Nadu states have sustainable fiscal policy in this period due to all series integrated order I(0). All series of Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Meghalaya, Maharashtra, Manipur, Madhya Pradesh, Mizoram, Nagaland, Punjab, Rajasthan, Sikkim, Uttar Pradesh, and West Bengal states are integrated at order of first difference I(1). The results presented in **Table 5**.

Table 4: Co-integration Test for Fiscal Policy Sustainability in Indian States: 1990-91 to 2022-23

States	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
AP	R/GSDP	[1 -0.390]	0.128	[1 -0.136]**	0.025	Sustainable
	E/GSDP	[1 -0.202]	0.544	[1 -7.334]**		
AR	R/GSDP	[1 -0.431]	0.104	[1 -0.017]***	0.000	Sustainable
	E/GSDP	[1 -0.171]	0.917	[1 -58.182]***		
AS	R/GSDP	[1 -0.355]	0.238	[1 -0.011]***	0.009	Sustainable
	E/GSDP	[1 -0.186]	0.462	[1 -94.054]***		
BR	R/GSDP	[1 -0.500]	0.113	[1 0.097]**	0.042	Sustainable
	E/GSDP	[1 -0.286]	0.311	[1 10.297]**		
GA	R/GSDP	[1 -0.246]	0.394	[1 0.168]***	0.003	Sustainable
	E/GSDP	[1 -0.226]	0.277	[1 5.951]***		
GJ	R/GSDP	[1 -0.337]	0.204	[1 0.207]**	0.048	Sustainable
	E/GSDP	[1 -0.285]	0.430	[1 4.842]**		
HP	R/GSDP	[1 -0.292]	0.180	[1 0.048]***	0.000	Sustainable
	E/GSDP	[1 -0.294]	0.398	[1 21.041]***		
HR	R/GSDP	[1 -0.410]*	0.056	[1 0.033]**	0.022	Sustainable
	E/GSDP	[1 -0.331]	0.368	[1 30.248]**		
JH	R/GSDP	[1 -0.355]	0.269	[1 -0.030]	0.656	No Co-integration (R<E)
	E/GSDP	[1 -0.408]	0.249	[1 -5.056]		
KA	R/GSDP	[1 -0.295]	0.221	[1 -0.030]*	0.068	Sustainable
	E/GSDP	[1 -0.154]	0.728	[1 -33.027]*		
MH	R/GSDP	[1 -0.277]	0.157	[1 0.059]**	0.011	Sustainable
	E/GSDP	[1 -0.197]	0.685	[1 16.845]**		
MN	R/GSDP	[1 -0.405]	0.223	[1 -0.051]***	0.001	Sustainable
	E/GSDP	[1 -0.188]	0.284	[1 -19.534]***		
MP	R/GSDP	[1 -0.332]	0.127	[1 0.100]**	0.038	Sustainable
	E/GSDP	[1 -0.194]	0.643	[1 10.037]**		
RJ	R/GSDP	[1 -0.348]	0.244	[1 -0.085]*	0.094	Sustainable
	E/GSDP	[1 -0.103]	0.765	[1 -11.724]*		
TR	R/GSDP	[1 -0.692]	0.239	[1 -0.220]	0.298	No Co-integration (R<E)
	E/GSDP	[1 -0.602]	0.264	[1 -4.550]		

States	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
UK	R/GSDP	[1 -0.035]	0.976	[1 -0.403]	0.974	No Co-integration (R<E)
	E/GSDP	[1 -0.219]	0.714	[1 -2.483]		
UP	R/GSDP	[1 -0.356]	0.151	[1 -0.014]**	0.026	Sustainable
	E/GSDP	[1 -0.204]	0.611	[1 -69.480]**		
WB	R/GSDP	[1 -0.254]	0.299	[1 0.135]*	0.052	Sustainable
	E/GSDP	[1 -0.233]	0.506	[1 7.421]*		

Source: Authors.

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Lag Length based on AIC.

Probability based on MacKinnon (1996) one-sided p-values.

R Total Revenue; E Total Expenditure.

Expenditure not included interest payment and debt services.

Table 5: Unit Root Test for Fiscal Policy Sustainability in Indian States during the Pre-FRBM Period: 1990-91 to 2003-04

States	Variables	At Level	First Difference	Results
AP	R/GSDP	-1.86	-5.88***	Co-integration
	E/GSDP	-2.02	-6.56***	
AR	R/GSDP	-2.11	-5.65***	Co-integration
	E/GSDP	-2.23	-4.55**	
AS	R/GSDP	-1.98	-4.40**	Co-integration
	E/GSDP	-1.59	-4.15**	
BH	R/GSDP	-3.09	-7.75***	Co-integration
	E/GSDP	-2.64	-6.81***	
GA	R/GSDP	-0.84	-6.55***	Co-integration
	E/GSDP	-0.95	-6.34***	
GJ	R/GSDP	-2.49	-7.40***	Co-integration
	E/GSDP	-1.75	-4.34**	
HP	R/GSDP	-1.53	-3.80*	Co-integration
	E/GSDP	-2.45	-6.26***	
HR	R/GSDP	-3.77*	-14.55***	Sustainable
	E/GSDP	-3.89**	-10.90***	
JK	R/GSDP	-3.05	-8.49***	Co-integration
	E/GSDP	-1.74	-3.52*	
KA	R/GSDP	-0.68	-9.14***	Co-integration
	E/GSDP	-0.91	-9.70***	

States	Variables	At Level	First Difference	Results
KL	R/GSDP	-0.85	-6.65***	Co-integration
	E/GSDP	-1.12	-7.15***	
ML	R/GSDP	-1.09	-4.15**	Co-integration
	E/GSDP	-1.24	-3.89*	
MH	R/GSDP	-1.76	-4.27**	Co-integration
	E/GSDP	-2.02	-4.59**	
MN	R/GSDP	-1.51	-4.60**	Co-integration
	E/GSDP	-2.67	-9.05***	
MP	R/GSDP	-2.15	-7.34***	Co-integration
	E/GSDP	-1.84	-5.85***	
MZ	R/GSDP	-3.28	-4.60**	Co-integration
	E/GSDP	-3.32	-6.62***	
NL	R/GSDP	-1.74	-5.62***	Co-integration
	E/GSDP	-2.45	-8.20***	
OR	R/GSDP	-3.81*	-4.92**	Unsustainability
	E/GSDP	-3.04	-4.87**	
PB	R/GSDP	-3.07	-11.58***	Co-integration
	E/GSDP	-2.43	-7.86***	
RJ	R/GSDP	-2.11	-7.61***	Co-integration
	E/GSDP	-1.92	-6.16***	
SK	R/GSDP	-2.28	-4.97**	Co-integration
	E/GSDP	-2.22	-4.53**	
TN	R/GSDP	-3.79*	-5.28***	Sustainability
	E/GSDP	-3.73*	-5.40***	
UP	R/GSDP	-2.39	-8.26***	Co-integration
	E/GSDP	-2.42	-8.87***	
WB	R/GSDP	-0.14	-9.27***	Co-integration
	E/GSDP	-0.71	-8.35***	

Source: Authors.

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

Lag Length based on AIC.

Probability based on MacKinnon (1996) one-sided p-values.

R Total Revenue; E Total Expenditure.

Expenditure not included interest payment and debt services.

The results of the co-integration tests (Table 6) reveal that, with the exception of Bihar, Gujarat and Karnataka states, the hypothesis of no co-integration is rejected for all states during the pre FRBM Act period. Thus, Andhra Pradesh, Arunachal Pradesh, Assam, Goa, Himachal Pradesh, Jammu & Kashmir, Kerala, Meghalaya, Manipur, Madhya Pradesh, Nagaland, Punjab, Rajasthan, Sikkim, Uttar Pradesh, and West

Bengal have achieved sustainability in fiscal policy over the pre FRBM Act period. But Maharashtra and Mizoram states show unsustainability in fiscal policy during this period due to estimated coefficient 'b' has greater than the one. Specifically, in Manipur, Himachal Pradesh, Sikkim and Kerala, public revenues increase by 3.272, 1.943, 1.850 and 1.369 percentage points of GDP, respectively. It is noteworthy that these four states exhibit the

highest absolute values of estimated coefficient 'b' in co-integrating vector (1, -b). For other states where a significant co-integration vector is identified, 'b' has a lower absolute value.

Table 6: Co-integration Test for Fiscal Policy Sustainability in Indian States during the Pre-FRBM Period: 1990-91 to 2003-04

States	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
AP	R/GSDP	[1 -1.467]***	0.003	[1 -0.931]**	0.014	Sustainable
	E/GSDP	[1 -1.502]***	0.002	[1 -1.075]**		
AR	R/GSDP	[1 -1.095]**	0.011	[1 -0.892]***	0.003	Sustainable
	E/GSDP	[1 -1.134]***	0.005	[1 -1.122]***		
AS	R/GSDP	[1 -0.871]**	0.043	[1 -1.586]***	0.000	Sustainable
	E/GSDP	[1 -0.889]**	0.016	[1 -0.630]***		
BH	R/GSDP	[1 -0.440]	0.654	[1 -1.180]	0.468	No Co-integration (R<E)
	E/GSDP	[1 -0.513]	0.516	[1 -0.847]		
GA	R/GSDP	[-0.410]	0.711	[1 -0.962]**	0.040	Sustainable
	E/GSDP	[1 -0.393]	0.739	[1 -1.039]**		
GJ	R/GSDP	[1 -0.523]	0.392	[1 -0.904]	0.251	No Co-integration (R<E)
	E/GSDP	[1 -0.543]	0.522	[1 -1.106]		
HP	R/GSDP	[1 -1.429]***	0.002	[1 -1.943]***	0.000	Sustainable
	E/GSDP	[1 -2.086]***	0.002	[1 -0.515]***		
JK	R/GSDP	[1 -0.990]**	0.021	[1 0.455]***	0.009	Sustainable
	E/GSDP	[1 -0.775]**	0.017	[1 -1.023]***		
KA	R/GSDP	[1 -0.466]	0.737	[1 -1.023]	0.251	No Co-integration (R<E)
	E/GSDP	[1 -0.497]	0.707	[1 -0.977]		
KL	R/GSDP	[1 -0.472]	0.670	[1 -1.369]**	0.020	Sustainable
	E/GSDP	[1 -0.475]	0.683	[1 -0.731]**		
ML	R/GSDP	[1 -0.816]	0.137	[1 -1.135]**	0.037	Sustainable
	E/GSDP	[1 -0.791]	0.172	[1 -0.881]**		
MH	R/GSDP	[1 -0.982]	0.119	[1 1.583]**	0.030	Unsustainable
	E/GSDP	[1 -1.036]*	0.094	[1 0.632]**		
MN	R/GSDP	[1 -0.798]	0.169	[1 -3.272]***	0.000	Sustainable
	E/GSDP	[1 -1.150]**	0.036	[1 -0.376]***		
MP	R/GSDP	[1 -0.980]*	0.056	[1 -0.949]**	0.028	Sustainable
	E/GSDP	[1 -0.973]**	0.048	[1 -1.054]**		

States	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
MZ	R/GSDP	[1 -0.968]	0.134	[1 2.482]*	0.062	Unsustainable
	E/GSDP	[1 -1.034]	0.100	[1 0.403]*		
NL	R/GSDP	[1 -1.503]	0.009	[1 -0.628]***	0.000	Sustainable
	E/GSDP	[1 -1.031]*	0.072	[1 -1.593]***		
PB	R/GSDP	[1 -1.110]**	0.012	[1 -1.218]***	0.000	Sustainable
	E/GSDP	[1 -1.054]**	0.014	[1 -0.821]***		
RJ	R/GSDP	[1 -0.942]	0.127	[1 -0.069]***	0.000	Sustainable
	E/GSDP	[1 -0.948]	0.131	[1 -14.441]***		
SK	R/GSDP	[1 -0.437]	0.785	[1 -1.850]**	0.018	Sustainable
	E/GSDP	[1 -0.469]	0.744	[1 -0.541]**		
UP	R/GSDP	[1 -1.198]	0.148	[1 -0.801]*	0.081	Sustainable
	E/GSDP	[1 -1.053]**	0.036	[1 -1.248]*		
WB	R/GSDP	[1 -0.586]	0.461	[1 -1.040]**	0.015	Sustainable
	E/GSDP	[1 -0.597]	0.470	[1 -0.961]**		

Source: Authors.

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

R Total Revenue; E Total Expenditure.

Expenditure not included interest payment and debt services.

The PP test reveals that, over the post-FRBM-Act period, Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jammu & Kashmir, Jharkhand, Meghalaya, Manipur, Madhya Pradesh, Mizoram, Nagaland, Orissa, Punjab, Uttarakhand states display an unsustainable fiscal policy characterized by a mixed order of Integration I (0), I (1), and I(2). Tripura state achieved sustainability in fiscal

policy in this period due to all series integrated order I (0). All series of Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Haryana, Karnataka, Kerala, Maharashtra, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, and West Bengal states are integrated at order of first difference I(1). The results presented in **Table 7**.

Table 7: Unit Root Test for Fiscal Policy Sustainability in Indian States during the Post-FRBM Period: 2004-05 to 2022-23

States	Variables	At Level	First Difference	Results
AP	R/GSDP	-2.46	-4.18**	Unsustainability
	E/GSDP	-7.12***	-9.17***	
AR	R/GSDP	-2.22	-4.34**	Co-integration
	E/GSDP	-2.72	-7.32***	

States	Variables	At Level	First Difference	Results
AS	R/GSDP	-1.14	-3.39*	Unsustainability
	E/GSDP	-1.75	-2.84	
BH	R/GSDP	-2.36	-4.13**	Co-integration
	E/GSDP	-2.52	-3.77**	
CG	R/GSDP	-1.73	-2.58	Unsustainability
	E/GSDP	-2.28	-5.22***	
GA	R/GSDP	-2.15	-3.82**	Co-integration
	E/GSDP	-1.99	-5.18***	
GJ	R/GSDP	-3.38*	-7.05***	Unsustainability
	E/GSDP	-2.38	-4.75***	
HP	R/GSDP	-2.11	-4.64***	Co-integration
	E/GSDP	-1.94	-3.59*	
HR	R/GSDP	-2.73	-8.29***	Co-integration
	E/GSDP	-2.23	-4.28**	
JK	R/GSDP	-1.26	-3.36*	Unsustainability
	E/GSDP	-3.68*	-14.35***	
JH	R/GSDP	-2.18	-3.19	Unsustainability
	E/GSDP	-2.78	-8.62***	
KA	R/GSDP	-2.73	-5.33***	Co-integration
	E/GSDP	-2.31	-5.09***	
KL	R/GSDP	-2.70	-5.11***	Co-integration
	E/GSDP	-2.79	-5.45***	
ML	R/GSDP	-1.61	-3.09	Unsustainability
	E/GSDP	-6.49***	-31.42***	
MH	R/GSDP	-1.62	-4.43**	Co-integration
	E/GSDP	-2.11	-5.02***	
MN	R/GSDP	-1.93	-4.23**	Unsustainability
	E/GSDP	-2.03	-2.78	
MP	R/GSDP	-2.68	-5.19***	Unsustainability
	E/GSDP	-2.03	-2.78	
MZ	R/GSDP	-3.31*	-5.36***	Unsustainability
	E/GSDP	-2.67	-6.23***	
NL	R/GSDP	-4.59***	-7.69***	Unsustainability
	E/GSDP	-3.20	-5.63***	
OR	R/GSDP	-0.93	-0.93	Unsustainability
	E/GSDP	-1.80	-4.67***	
PB	R/GSDP	-1.58	-6.70***	Unsustainability
	E/GSDP	-3.93**	-13.06***	
RJ	R/GSDP	-2.82	-5.18***	Co-integration
	E/GSDP	-2.41	-4.91***	
SK	R/GSDP	-1.74	-3.64*	Co-integration
	E/GSDP	-2.25	-3.48*	
TN	R/GSDP	-2.02	-4.96***	Co-integration
	E/GSDP	-2.34	-4.06**	

States	Variables	At Level	First Difference	Results
TR	R/GSDP	-5.51***	-9.06***	Sustainability
	E/GSDP	-5.96***	-4.04**	
UK	R/GSDP	-1.59	-4.77***	Unsustainability
	E/GSDP	-3.49*	-6.38***	
UP	R/GSDP	-3.21	-10.76***	Co-integration
	E/GSDP	-2.34	-8.21***	
WB	R/GSDP	-1.67	-6.44***	Co-integration
	E/GSDP	-2.54	-6.91***	

Source: Authors.

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

R Total Revenue; E Total Expenditure.

Expenditure not included interest payments and debt services.

The results of the co-integration tests (Table 8) reveal that, with the exception of Arunachal Pradesh, Goa, Himachal Pradesh, Haryana, Karnataka, Kerala, Rajasthan and Sikkim states, the hypothesis of no co-integration is rejected for all states during the post FRBM Act period. In light of these findings, it can be inferred that Bihar, Maharashtra, Tamil Nadu, Uttar Pradesh and West Bengal have achieved sustainability in fiscal policy over the post FRBM Act period.

Specifically, in Bihar, Maharashtra, Tamil Nadu and West Bengal public revenues increase by 0.236, 0.221, 0.178 and 0.116 percentage points of GDP, respectively. It is noteworthy that these four states exhibit the highest absolute values of the estimated coefficient 'b' in the co-integrating vector (1, -b). For the other states where a significant co-integration vector was identified, 'b' has an even lower absolute value.

Table 8: Co-integration Test for Fiscal Policy Sustainability in Indian States during the Pre-FRBM Period: 1990-91 to 2003-04

States	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
AR	R/GSDP	[1 -1.097]**	0.012	[1 -0.068]	0.183	Unsustainability
	E/GSDP	[1 -1.218]***	0.005	[1 -14.717]		
BH	R/GSDP	[1 -0.263]	0.846	[1 0.236]*	0.065	Sustainability
	E/GSDP	[1 -0.412]	0.527	[1 4.229]*		
GA	R/GSDP	[1 -0.514]	0.673	[1 -0.033]	0.416	No Co-integration (R<E)
	E/GSDP	[1 -0.211]	0.848	[1 -30.485]		
HP	R/GSDP	[1 -0.685]	0.287	[1 -0.026]	0.528	No Co-integration (R<E)
	E/GSDP	[1 -0.261]	0.861	[1 -39.074]		
HR	R/GSDP	[1 -0.680]	0.432	[1 -0.477]	0.796	No Co-integration (R<E)
	E/GSDP	[1 -0.488]	0.376	[1 -2.096]		

States	Dependent Variables	Engel-Granger (tau) Co-integration Test		Johansen (trace) Co-Integration test		Results
		Vector	P-Value	Vector	P-Value	
KA	R/GSDP	[1 -0.343]	0.804	[1 -0.507]	0.299	No Co-integration (R<E)
	E/GSDP	[1 -0.462]	0.522	[1 -1.973]		
KL	R/GSDP	[1 -0.514]	0.397	[1 -0.241]	0.139	No Co-integration (R<E)
	E/GSDP	[1 -0.575]	0.264	[1 -4.142]		
MH	R/GSDP	[1 -0.482]	0.631	[1 -0.221]*	0.074	Sustainability
	E/GSDP	[1 -0.486]	0.749	[1 -4.529]*		
RJ	R/GSDP	[1 -0.030]	0.985	[1 -1.092]	0.411	No Co-integration (R<E)
	E/GSDP	[1 -0.492]	0.409	[1 -0.916]		
SK	R/GSDP	[1 -0.459]	0.540	[1 -0.767]	0.290	No Co-integration (R<E)
	E/GSDP	[1 -0.551]	0.442	[1 -1.304]		
TN	R/GSDP	[1 -0.610]	0.114	[1 -0.178]***	0.000	Sustainability
	E/GSDP	[1 -0.459]	0.802	[1 -5.627]***		
UP	R/GSDP	[1 -0.212]	0.712	[1 0.086]*	0.055	Sustainability
	E/GSDP	[1 -0.542]	0.315	[1 11.571]*		
WB	R/GSDP	[1 -1.345]***	0.002	[1 -0.116]***	0.001	Sustainability
	E/GSDP	[1 -2.031]***	0.003	[1 -8.623]***		

Source: Authors.

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%.

R Total Revenue; E Total Expenditure.

Expenditure not included interest payment and debt services.

3.4. Summary of fiscal policy sustainability in Indian states

Results in **Table 9** shows that an analysis of the pre-FRBM-Act period reveals distinct patterns in the sustainability of fiscal policies among Indian states. In the very high developed states category, Kerala, Goa, Himachal Pradesh, Sikkim, Jammu & Kashmir, and Punjab demonstrate sustainability. In the developed states category, Haryana, Tamil Nadu, Manipur, Nagaland, and Arunachal

Pradesh also exhibit fiscal sustainability, whereas Maharashtra, Mizoram, and Karnataka display unsustainability. In the moderately developed states category, Meghalaya, Rajasthan, Andhra Pradesh, and West Bengal demonstrate fiscal sustainability, while Gujarat shows unsustainability. Moving to the low-developed states category, Assam, Madhya Pradesh, and Uttar Pradesh exhibit fiscal sustainability. Conversely, Orissa and Bihar show the unsustainability of fiscal policy.

Table 9: Summary of Fiscal Policy Sustainability in Indian States

Period	Classification	Sustainability	Unsustainability
Pre-FRBM Act Period	Very Developed States	KL GA HP SK JK PB	
	Developed States	HR TN MN NL AR	MH MZ KA
	Moderate Developed States	ML RJ AP WB	
	Low Developed States	AS MP UP	OR BH
Post-FRBM Act Period	Very Developed States		JK PB
	Developed States	MH TN AR	MZ MN UK NL HR KA
	Moderate Developed States	TR WB	ML, GJ, AP
	Low Developed States	UP BH	CG AS OR MP JH
Total Period	Very Developed States	GA, HP, JK	KL SK PB
	Developed States	HR MH MN KA AR	MZ TN NL
	Moderate Developed States	GJ RJ AP WB	ML
	Low Developed States	AS MP UP BR	CG OR

Source: Author Calculation from RBI Data.

In the analysis of the post-FRBM-Act period, discernible trends emerge regarding the sustainability of fiscal policies in various Indian states. Within the very high developed states category, Jammu & Kashmir, Punjab, Kerala, Goa, Himachal Pradesh, Sikkim exhibit unsustainability. Moving to the developed states category, Maharashtra, Tamil Nadu, and Arunachal Pradesh demonstrate sustainability, whereas Mizoram, Manipur, Uttarakhand, Nagaland, Haryana and Karnataka exhibit unsustainability in fiscal policy. In the moderately developed states category, Tripura and West Bengal showcase sustainability, while Meghalaya, Gujarat, and Andhra Pradesh and Rajasthan exhibit unsustainability. Within the low developed states category, Uttar Pradesh and Bihar display fiscal sustainability, while Chhattisgarh, Assam, Orissa, Madhya Pradesh, and Jharkhand exhibit unsustainability as indicated in Table 9.

In the analysis across the total period, distinct patterns emerge regarding the sustainability of

fiscal policies in various Indian states. Within the very high developed states category, Goa, Himachal Pradesh, and Jammu & Kashmir showcase fiscal sustainability, while Kerala, Sikkim, and Punjab exhibit unsustainability. Moving to the developed states category, Haryana, Maharashtra, Manipur, Karnataka, and Arunachal Pradesh demonstrate fiscal sustainability, while Mizoram, Tamil Nadu, Nagaland and Uttarakhand show unsustainability. In the moderately developed states category, Gujarat, Rajasthan, Andhra Pradesh, and West Bengal display fiscal sustainability, whereas Meghalaya and Tripura exhibit unsustainability. Within the low-developed states category, Assam, Madhya Pradesh, Uttar Pradesh, and Bihar exhibit fiscal sustainability, while Chhattisgarh, Orissa, and Jharkhand show unsustainability (Table 9).

In the analysis of the pre-FRBM Act period, Karnataka was categorized as displaying unsustainability in fiscal policy, along with Maharashtra and Mizoram among developed states. Moving to the post-FRBM Act period,

Karnataka continued to exhibit unsustainability in fiscal policy, similar to Maharashtra and Manipur among developed states. Across the entire period, Karnataka showed a pattern of fiscal unsustainability, alongside Maharashtra and Nagaland within the developed states category. These findings highlight the need for Karnataka to strengthen fiscal management strategies, focusing on revenue enhancement, expenditure rationalization, and adherence to fiscal responsibility frameworks to achieve sustainability in public finances.

4. Conclusion and implications

The analysis presents a comprehensive overview of fiscal sustainability across various states in India, both before and after the implementation of the Fiscal Responsibility and Budget Management (FRBM) Act. The findings highlight the dynamics of fiscal sustainability, considering factors such as co-integration tests and unit root results.

Fiscal policy sustainability is critical to economic stability and growth for central and state governments. The findings reveal significant variations in sustainability across different states and periods, suggesting the influence of regional economic factors and policy frameworks. The post-FRBM-Act period appears to have had divergent effects on fiscal sustainability between central and state governments. While the central government achieved fiscal policy sustainability during this period, many state governments struggled to maintain the same level of sustainability, particularly in comparison to the pre-FRBM-Act period. States such as Jammu & Kashmir, Haryana, and Tamil Nadu exhibited sustainable fiscal policies during specific periods, as indicated by co-integration and unit root test results. However, the sustainability varied across different phases, highlighting the need for ongoing monitoring and adaptation of fiscal policies to changing economic conditions. Highly developed states like Kerala, Goa, and Himachal Pradesh

initially demonstrated fiscal sustainability before the FRBM-Act but faced challenges in sustaining it post-implementation. This trend suggests the complexity of managing fiscal affairs in regions with relatively advanced economies. Similarly, variations within the developed states category are observed between periods, with some states maintaining sustainability while others faced challenges. This underscores the importance of context-specific policy interventions tailored to the unique economic circumstances of each state. Moderately developed and low-developed states exhibited similar patterns of fluctuating fiscal sustainability across periods. While some states managed to achieve sustainability in certain periods, others struggled to maintain it consistently, reflecting the broader economic disparities and challenges these regions face. The findings also highlight specific states where sustainability problems persisted consistently across periods, such as Jharkhand, Tripura, and Uttarakhand, indicating the need for targeted interventions and reforms to address underlying structural issues.

In the pre-FRBM Act period, Maharashtra, Mizoram, Karnataka, Orissa, and Bihar exhibited unsustainable fiscal policies. In the post-FRBM Act period, Jammu and Kashmir, Punjab, Mizoram, Manipur, Uttarakhand, Nagaland, Mizoram, Gujarat, Andhra Pradesh, Chhattisgarh, Assam, Orissa, Madhya Pradesh, and Jharkhand faced similar challenges. Over the entire period under consideration, Kerala, Sikkim, Punjab, Mizoram, Tamil Nadu, Nagaland, Mizoram, Chhattisgarh, and Orissa struggled with unsustainable fiscal policies. These states grappled with such challenges due to their reliance on volatile revenue sources, such as sales tax or stamp duties, leading to revenue fluctuations that hindered effective budgetary resource management. Moreover, the increasing expenditure demands in critical sectors like healthcare, education, and infrastructure consistently outpaced revenue growth, resulting in persistent budget deficits and debt accumulation. Therefore, there is need to Implement measures

to diversify revenue sources and enhance fiscal discipline to mitigate reliance on volatile revenues and align expenditure growth with revenue generation. Overall, the analysis underscores the heterogeneous nature of fiscal policy sustainability across Indian states, influenced by factors such as economic development levels, policy frameworks, and external economic shocks. Moving forward, policymakers must prioritize strategies to enhance fiscal resilience, improve revenue generation, and foster economic growth to ensure long-term sustainability and stability across all regions.

Based on the above analysis, it is evident that fiscal policy sustainability varies significantly across states and periods, with several states facing challenges in maintaining sustainable fiscal practices, particularly after the implementation of the FRBM Act. To address these challenges and promote fiscal stability across all regions, policymakers should consider the following key policy suggestions: Firstly, there is a need for targeted fiscal reforms aimed at enhancing revenue generation and expenditure management in states experiencing sustainability problems, particularly those where expenditure consistently exceeds revenue. This could involve measures such as rationalizing expenditure, improving tax administration, and exploring alternative revenue sources to reduce fiscal deficits and promote long-term sustainability. Secondly, states should focus on strengthening institutional frameworks for fiscal governance, including better fiscal planning, budgetary transparency, and accountability mechanisms. This could help ensure more effective monitoring and evaluation of fiscal policies, as well as greater adherence to fiscal rules and targets set under the FRBM Act. Thirdly, promoting regional economic development through targeted investment in infrastructure, education, and healthcare can help boost revenue generation and improve fiscal sustainability in less-developed states. By addressing structural barriers to growth and fostering inclusive development, policymakers can create a more

conducive environment for sustainable fiscal management across all states. Lastly, fostering greater collaboration and coordination between central and state governments is crucial for addressing fiscal challenges holistically. This could involve initiatives such as joint fiscal planning, resource-sharing mechanisms, and capacity-building programs to enhance fiscal management capabilities at the state level. By implementing these policy suggestions, policymakers can work towards achieving greater fiscal sustainability and economic resilience across all states, thereby contributing to overall economic stability and growth in the country.

References

- ADBI (1999). Public Expenditure Management. ADBI Executive Summary Series, No.S17/00. <https://www.adb.org/sites/default/files/publication/159141/adbi-ess17.pdf>
- Ahmed, S. and Rogers, J. (1995). Government Budget Deficits and Trade Deficits. Are Present Value Constraints Satisfied In Long-Term Data? *Journal of Monetary Economics*, 36 (2), 351-374.
- António Afonso (2004). Fiscal Sustainability: The Unpleasant European Case. *FinanzArchiv / Public Finance Analysis*, 61(1), 19-44.
- Bohn, H. (1991). The Sustainability of Budget Deficits with Lump-Sum and with Income-Based Taxation. *Journal of Money, Credit, and Banking*, 23(3), Part 2, 581-604.
- Bohn, H. (1998). The Behavior of U. S. Public Debt and Deficits. *Quarterly Journal of Economics*, 113 (3), 949-963.
- Buiter, W. (2002). The Fiscal Theory of the Price Level: A Critique. *Economic Journal*, 112 (481), 459-480.
- Cuddington, J. (1997). Analysing the Sustainability of Fiscal Deficits in Developing Countries. Policy Research Working Paper, No

1784, World Bank.

<https://globaldatalab.org/shdi/download/shdi/IND/?levels=1+4>

Hakkio, C.S. and Rush, M. (1991). Is the Budget Deficit “Too Large?” *Economic Inquiry*, 29, 429-445.

Hénin, P. (1997). Soutenabilité des déficits et ajustements budgétaires,” *Révue Économique*. 48 (3), 371-395.

IMF & World Bank (2001). Guidelines for Public Debt Management. Prepared by the Staffs of the International Monetary Fund and the World Bank.

Jha, R., & Sharma, A. (2001). Structural Breaks and Unit Roots: A Further Test of the Sustainability of the Indian Fiscal Deficit. ASARC Working Paper, 1–26.

Joines, D. (1991). How Large A Federal Deficit Can We Sustain? *Contemporary Policy Issues*, 9 (3), 1-11.

Kappagoda, N. (2001). Public Debt Management: A New Priority, *Bulletin on Asia–Pacific Perspectives 2001/02*, ESCAP, United Nations.

Keynes, J. (1923). A Tract on Monetary Reform, in the *Collected Writings of John Maynard Keynes*, vol. IV, Macmillan, 1971.

Kumar, Manmohan S. and Ter-Minassian Teresa (2007). Promoting Fiscal Discipline. <https://www.imf.org/en/Publications/Books/Issues/2016/12/31/Promoting-Fiscal-Discipline-19694>

Manmohan S. Kumar and Teresa Ter-Minassian (2007). *Fiscal Discipline: Key Issues*

and Overview. Promoting Fiscal Discipline, International Monetary Fund.

McCallum, B. (1984). Are Bond-Financed Deficits Inflationary? A Ricardian Analysis, *Journal of Political Economy*, 92 (1), 123-135.

Payne, J. (1997). International Evidence on the Sustainability of Budget Deficits, *Applied Economics Letters*, 12 (4), 775-779.

Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica*, 57(6), 1361–1401.

Phillips, P.C.B., P. Perron, (1988). Testing For A Unit Root In Time Series Regression, *Biometrika*, 75, 335-346.

Quintos, C. (1995), Sustainability of the Deficit Process with Structural Shifts, *Journal of Business & Economic Statistics*. 13. 409-417

Tanner, E. and Liu, P. (1994). Is The Budget Deficit “Too Large? Some Further Evidence. *Economic Inquiry*, 32, 511-518.

Trehan, B. and Walsh, C. (1988). Common Trends, The Government’s Budget Constraint, and Revenue Smoothing. *Journal of Economic Dynamics and Control*, 12 (2/3), 425-444.

Trehan, B. and Walsh, C. (1991). Testing Intertemporal Budget Constraints: Theory and Applications to U.S. Federal Budget and Current Account Deficits, *Journal of Money, Credit, and Banking*, 23 (2), 206-223.

Wheeler, G. (2004). *Sound Practice in Government Debt Management*. The International Bank for Reconstruction and Development/ The World Bank, Washington.

Annexure 1:**Theoretical background for fiscal sustainability analysis****Fiscal sustainability**

Fiscal sustainability, a recurring concern for both nations and international organizations, has historical roots dating back to the 1920s. Keynes emphasized the importance of sustainable fiscal policy for France, noting that an unsustainable situation arises when the government's contractual liabilities become excessively high as a proportion of national income (Keynes, 1923). In contemporary terms, this is reflected in sustainability challenges when the debt-to-GDP ratio becomes excessive. The core issue emerges when government revenues fall short of covering the expenses linked to new public debt issuance. Fiscal policy sustainability is often linked to government financial solvency. In practice, empirical studies examine whether future public expenditures and government revenues can maintain historical growth patterns. If a fiscal policy proves unsustainable, adjustments are needed to ensure future primary balances align with the budget constraint (Cuddington, 1997; Hénin, 1997). While a budget deficit is theoretically possible with limitless government liabilities, practical constraints arise from the present value of a government's budget limitations. Fiscal policy sustainability hinges on the idea that the trajectory of key macroeconomic variables remains unaffected by choosing between public debt issuance and tax increases. In such circumstances, the method of financing deficits becomes irrelevant, implying adherence to the Ricardian equivalence hypothesis. The government budget constraint serves as a foundation for establishing limitations on present value of a budget. The flow budget constraint is expressed as follows (António Afonso, 2004):

$$G_t + (1+r_t) B_{t-1} = R_t + B_t \quad (1)$$

Where G represents government expenditures (excluding interest payments), R is government revenues, B is public debt, and r is the real interest rate. Intertemporal budget constraint is derived by rewriting equation (Eq.1) for subsequent periods and recursively solving, resulting in the following expression:

$$B_t = \sum_{s=1}^{\infty} \frac{R_{t+s} G_{t-s}}{\prod_{j=1}^s (1+r_{t+j})} + \lim_{s \rightarrow \infty} \prod_{j=1}^s \frac{B_{t+s}}{(1+r_{t+1})} \quad (2)$$

When the second term on right-hand side (RHS) of equation (Eq.2) becomes zero, the present value of current public debt stock equals present value of future primary surpluses. However, equation (Eq.2) is not suitable for empirical testing. Therefore, it is beneficial to introduce several algebraic modifications to the equation (Eq.1). Assuming stationarity of real interest rate with a mean of r and defining, equation (1) can be rewritten as follows:

$$E_t = G_t + (r_t - r) B_{t-1} \quad (3)$$

It is possible to derive the following Present Value Budget Constraint (PVBC) (António Afonso, 2004):

$$B_t = \sum_{s=1}^{\infty} \frac{1}{(1-r)^{s+1}} R_{t+s} - E_{t+s} + \lim_{s \rightarrow \infty} \prod_{j=1}^s \frac{B_{t+s}}{(1+r)^{s+1}} \quad (4)$$

A sustainable fiscal policy should guarantee that present value of public debt stock, represented by second term on right-hand side of equation (Eq.4), converges to zero over time. This constraint ensures that debt does not grow at a pace exceeding real interest rate. In simpler terms, real-term public debt cannot indefinitely increase at a rate surpassing real interest rate (Joines, 1991; McCallum, 1984).

It is also feasible to establish the solvency condition, by adopting variables expressed as percentages of GDP (Hakkio and Rush, 1991). The Present Value Budget Constraint (PVBC), with variables presented as ratios of GDP,

incorporating y as real GDP growth rate, and excluding seigniorage revenues for presentation clarity, can be expressed as follows:

$$\frac{B_t}{Y_t} = \frac{(1+r_t) B_{t-1}}{(1+y_t) Y_{t-1}} + \frac{G_t}{Y_t} - \frac{R_t}{Y_t} \quad (5)$$

Assuming stationarity of real interest rate with a mean of r , and incorporating constant real growth, the budget constraint can be expressed as follows:

$$B_t = \sum_{s=1}^{\infty} \left(\frac{1+y}{1+r}\right)^{(s+1)} [\rho_{t+s} - e_{t+s}] + \lim_{s \rightarrow \infty} b_{t+s} \left(\frac{1+y}{1+r}\right)^{(s+1)} \quad (6)$$

With $b_t = \frac{B_t}{Y_t}$, $e_t = \frac{E_t}{Y_t}$ and $\rho_t = \frac{R_t}{Y_t}$. When $r > y$, it becomes necessary to present a solvency condition, given by $\lim_{s \rightarrow \infty} b_{t+s} \left(\frac{1+y}{1+r}\right)^{(s+1)} = 0$, to bound public debt growth. This implies that growth rate of debt-to-GDP ratio should be limited to a value less than the factor $\left(\frac{1+y}{1+r}\right)^{(s+1)}$. This leads to the well-known outcome that fiscal policy is sustainable when present value of future stream of primary surpluses, as a percentage of GDP, aligns with existing stock of government debt ("inherited" debt) (Buiter, 2002). Buiter (2002) argues that the intertemporal government budget constraint must be satisfied at all times, not just in equilibrium. This stands as Buiter's primary critique of the fiscal theory of the price level (Buiter, 2002).

Assessment of the sustainability of public deficits

A prevalent approach in the literature, among various methods for assessing fiscal policy sustainability, involves examining historical fiscal data to determine if government debt exhibits a stationary process or to establish co-integration between government revenues and expenditures (Hamilton and Flavin, 1986; Trehan and Walsh, 1991; Hakkio and Rush, 1991).

Recalling the Present Value Budget Constraint (PVBC), expressed in equation (4), it is feasible to articulate two complementary definitions

of sustainability that lay the groundwork for empirical testing:

I. The value of current public debt should equal the sum of future primary surpluses:

$$B_t = \sum_{s=1}^{\infty} \frac{1}{(1+r)^{s+1}} [R_{t+s} - E_{t+s}] \quad (7)$$

I. The present value of public debt should converge to zero over time:

$$\lim_{s \rightarrow \infty} \frac{B_{t+s}}{(1+r)^{s+1}} = 0 \quad (8)$$

It is also feasible to evaluate fiscal policy sustainability through co-integration tests. The underlying assumption regarding the real interest rate, with a mean of r , is also stationarity. Employing the auxiliary variable $E_t = G_t + (r_t - r) B_{t-1}$ and additional definition $GG_t = G_t + r_t B_{t-1}$, the intertemporal budget constraint can be expressed as follows:

$$GG_t - R_t = \sum_{s=1}^{\infty} \frac{1}{(1+r)^{s+1}} (\Delta R_{t+s} - \Delta E_{t+s}) + \lim_{s \rightarrow \infty} \frac{B_{t+s}}{(1+r)^{s+1}} \quad (9)$$

Assuming that R and E are non-stationary variables, and their first differences are stationary variables, it implies that the series R and E in levels are $I(1)$. For equation (9) to be valid, its left-hand side must also be stationary. If we can assert that GG and R are integrated of order 1, these two variables should be co-integrated with a co-integration vector of $(1, -1)$ for the left-hand side of equation (9) to be stationary.

Thus, the procedure for evaluating the sustainability of the intertemporal government budget constraint involves testing the following co-integration regression: $R_t = \delta + bGG_t + u_t$. If a null hypothesis of no co-integration, indicating that two $I(1)$ variables are not co-integrated, is rejected, it implies accepting the alternative hypothesis of co-integration. For this outcome to hold, the series of residual u_t must be stationary and should not

District Mineral Foundation (DMF) Funds and Socio-economic Development of Districts in Karnataka State

Shashwat N Doshetti¹ and Pushpa M Savadatti²

Abstract

Government of India launched the District Mineral Fund under the Benefit-Sharing Principle in 2015 to mitigate the negative impact of mining activities on the socio-economic conditions of the mining-affected communities. This paper builds upon the District Mineral Fund Utilization Index and extends to a more localized level (districts). Despite Karnataka's district's significant fund collection, a weak positive correlation between the financial metrics and effective Fund utilization highlights the inefficiencies and need for improved Fund management practices.

JEL Classification Codes: Q32, Q38, R58, H76, O13, O22

1. Introduction

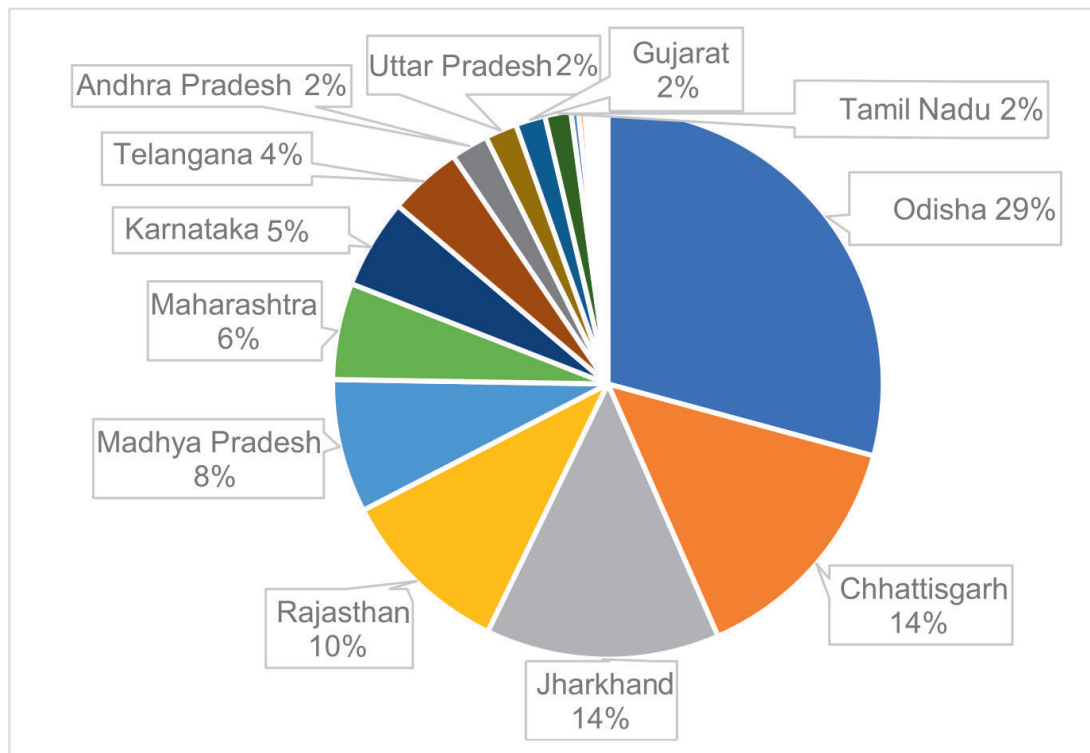
The mining sector plays a vital role in the nation's industrial and economic landscape by providing raw materials for numerous industries, from steel and cement to electronics and energy. India's mining sector includes coal, iron ore, bauxite, and various precious metals. Mining contributes 2.5 percent of India's Gross Domestic Product (GDP) (Abraham, 2022). However, the mining sector's expansion has come with challenges. Historically, mining activities have led to the displacement of local and indigenous communities, resulting in socio-economic disruptions and environmental degradation (Narasimham & Subbarao, 2018). The Benefit Sharing Principle (BSP) aimed to ensure the just distribution of the mining sectors' dividends, active participation, and upliftment of the affected communities, ensuring they receive a fair share of their rights (Dupuy, 2016). Doing so solves the historical inequalities and paves the way for sustainable and harmonious growth in the mining sector. Under this BSP, the government can

share the benefits for several reasons, like claims by local communities over natural resources, compensating for environmental degradation, contributing to socio-economic development, and avoiding civil conflict in these regions (Ghose, 2018, p. 9). Government of India adopted this BSP to guarantee the socio-economic welfare of mining-affected regions and communities and set up the District Mineral Foundation (DMF) Funds. Through the DMF, a portion of the revenues from the mining activities is directly spent to support for development projects and initiatives in the mining districts of India.

Figure 1 shows that the combined collection of DMF funds by all States is about Rs. 87,049.02 crores (Coal & Lignite, Major Minerals, and Minor Minerals) as of 31-12-2023. Odisha leads in DMF collection (Rs.25,426.39 crores), followed by Chhattisgarh (12,396.51 crores), Jharkhand (11,960.27 crores), Rajasthan (8,897.64 crores), Madhya Pradesh (6,829.98 crores), Maharashtra (4,940.51 crores), and Karnataka (4,587.16 crores).

¹ Research Scholar, Central University of Karnataka, Kalaburagi-585367. E-mail: shashwatcuk@gmail.com

² Senior Professor, Central University of Karnataka, Kalaburagi-585367. E-mail: pmsavadatti@cuk.ac.in

Figure 1: DMF Fund Collection by States as of 31st March 2023

Source: Ministry of Mines DMF Collection last updated data 31st Dec 2023.

Karnataka State presents an interesting case where the ratio of allocation to DMF collection is about 125 percent, which is the highest among the top mining states. In contrast, the ratio of expenditure to collection is 30.8 percent, which is the lowest compared to the other mineral-rich states in India. In addition, Karnataka's expenditure on the collection is 38.6 percent of the total collection, which is the second lowest compared to the other mining States (Chadha & Kapoor, 2022). Thus, Karnataka State has allocated more funds than what is collected, the actual expenditure is lower than the allocated and collected funds. In this context, the following research questions are relevant. First, how does the District Mineral Fund Utilization Fund (DMFUI) illuminate the utilization of the DMF funds across districts in Karnataka? Second, how can the District Mineral Fund Utilization Index (DMFUI) be used to rank the districts of Karnataka in terms of their efficiency and effectiveness in utilizing the DMF funds for development projects? Third, how do financial metrics influence the effectiveness of the

District Mineral Funds Utilization in advancing the socio-economic developmental objectives? The main objective of this paper is to answer these research questions which are of current and future policy relevance for Karnataka State.

2. Methodology

To analyse the DMF funds, we need district-level data in the State. Our methodology includes an equal assignment of weights across the indicators by quantitative and qualitative sub-categories (16.67%). The balanced approach is adopted because both the quantitative and qualitative distribution of the funds are integral in understanding the comprehensive welfare impact of the DMF Projects and no single category disproportionately influences the overall index. In short, our methodology is built on the initially developed (Chadha & Kapoor, 2022) for the state-level DMF utilization Index. The difference between the original and our methodology is shown in Table 1.

Table 1: Comparison of Methodological Approaches for Evaluating DMF Fund Utilization

Indicators	Chadha and Kapoor (2022) Methodology		Our Methodology	
	Sub-Categories	Weight- age	Sub-Categories	Weight- age
Quantitative Indicators	Allocation to Collection Ratio	16.67	Sanctioned to collection Ratio	16.67
	Expenditure to Collection Ratio	33.33	Expenditure to Collection Ratio	16.67
			Completed Projects to Number of Projects	16.67
Qualitative Indicators	Percentage of allocated funds to high-priority areas	16.67	Percentage of sanctioned funds to high-priority areas	16.67
	Spread of allocation across high-priority areas	16.67	Spread of sanctioned funds across high-priority areas	16.67
	Spread of allocation towards the other priority areas	16.67	Spread of sanctioned funds toward the other priority areas	16.67

Source: Authors.

Thus, to construct an index to evaluate the utilization of the District Mineral Foundation (DMF) Fund, we incorporate both the quantitative and the qualitative indicators. This balanced approach ensures a comprehensive assessment that captures the fund management's numerical assessment and the funds' qualitative impact on the developmental areas.

3. Analysis and Findings

In analysing the effectiveness and impact of the DMF initiatives across various districts, the DMF Fund Utilization Index (DMFUI) is developed, incorporating a mix of both quantitative and qualitative indicators in Table 1. The quantitative indicators, comprising 50% of the total weight, include Sanctioned to Collection Indicators,

Expenditure to Collection Indicators, and Number of Projects to the Completed Projects, each with an equal weight of 16.67%. The qualitative indicators (percentages of total allocation spent toward the high-priority areas, spread of allocation across high-priority areas, and spread of allocation toward other priority areas) hold 50% of the total weight. Applying the min-max normalization technique, the data for each sub-category is transformed to a standard scale without distorting differences in the range of values. This technique re-scales the distribution of data values to a scale of 0 to 1, ensuring comparability across different scales and allowing for an integrated assessment of the DMFUI. The transformed scores for each sub-category are combined according to their respective weights to yield a composite DMF utilization Score for each district. This score

represents an aggregate measure of the district's performance across all considered indicators, reflecting the allocated funds and the extent of project implementation. After the DMFUI score, we conduct the correlational analysis between the financial metrics, the total collection, sanctioned amount, and expenditure amount, to examine their impact on the DMFUI. Basic data on quantitative and qualitative indicators are given in Annexure (Tables A-1, A-2, and A-3).

3.1. Quantitative Indicator Measurement

For district-level quantitative indicator analysis, we normalized the key ratios using the min-max method for comparison, with weights being assigned equally; the "sanctioned to collection ratio" reflects the amount allocated for the mining-affected areas relative to actual collection, reflects the financial health and administrative efficiency. Results are given in Table 2. Vijayanagara district is placed at higher than other districts, and funds are assigned for the developmental work. "Expenses to Collection Ratio" assesses

the spending efficiency against the collected funds and shows the efficiency of financial management. Vijayanagara district is placed highest and leads in the expenses to collection ratio. "Completed to number of projects" reflects the efficiency and the effectiveness of project completion. Yadgir district scores the highest in this indicator.

The values of the Quantitative Indicator in Tables 2 refer to the year 2023, sourced from the data accessed on 15 November 2023. The colour coding indicates the differential performance levels, with green representing high performance, white representing moderate performance, and red representing low performance. The colour differences are determined based on the normalized values for each indicator, with darker shades of green, white, and red indicating higher performance, moderate performance, and lower performance, respectively. As the colour shades fade, the values decrease, providing a clear visual representation of performance levels across districts.

Table 2: Results for Quantitative Indicators by Districts in Karnataka state

District	Sanctioned to Collection Ratio	Normalized (Min-Max)	Sanctioned to Collection Ratio Weight	Expense to Collection Ratio	Normalized (Min-Max)	Expense to Collection Ratio Weight	Completed to Projects Ratio	Normalized (Min-Max)	Completed to Projects Ratio Weight
Bagalkot	1.07	29.43	4.91	0.67	49.57	8.26	0.62	62.46	10.41
Ballari	0.81	19.97	3.33	0.29	21.57	3.60	0.46	46.22	7.71
Belagavi	0.72	16.98	2.83	0.61	45.44	7.58	0.15	15.36	2.56
Bengaluru (Rural)	1.00	26.86	4.48	0.55	41.11	6.85	0.35	34.80	5.80
Bengaluru (Urban)	1.59	47.89	7.98	0.79	58.78	9.80	0.59	59.31	9.89
Bidar	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chamarajanagara	0.82	20.51	3.42	0.36	26.53	4.42	0.21	20.97	3.50
Chikkaballapura	1.43	42.12	7.02	0.48	35.31	5.89	0.40	39.74	6.62

District	Sanctioned to Collection Ratio	Normalized (Min-Max)	Sanctioned to Collection Ratio Weight	Expense to Collection Ratio	Normalized (Min-Max)	Expense to Collection Ratio Weight	Completed to Projects Ratio	Normalized (Min-Max)	Completed to Projects Ratio Weight
Chikkamagaluru	0.93	24.26	4.04	0.53	39.13	6.52	0.23	23.15	3.86
Chitradurga	0.79	19.58	3.26	0.53	39.46	6.58	0.30	29.51	4.92
Dakshina Kannada	0.26	0.39	0.06	0.23	16.77	2.80	0.77	76.79	12.80
Davanagere	0.83	20.89	3.48	0.80	59.03	9.84	0.71	71.43	11.91
Dharwad	0.89	23.05	3.84	0.66	48.65	8.11	0.80	80.45	13.41
Gadag	0.56	11.35	1.89	0.42	31.48	5.25	0.47	47.31	7.89
Hassan	0.68	15.50	2.58	0.55	40.78	6.80	0.92	92.28	15.38
Haveri	1.15	32.35	5.39	0.25	18.84	3.14	0.11	10.66	1.78
Kalburgi	1.60	48.20	8.03	0.27	20.01	3.34	0.34	33.51	5.59
Kodagu	0.45	7.40	1.23	0.30	22.55	3.76	0.06	5.88	0.98
Kolar	0.44	6.77	1.13	0.19	14.34	2.39	0.51	51.25	8.54
Koppal	1.43	42.44	7.07	0.64	47.25	7.88	0.34	33.91	5.65
Mandya	0.88	22.57	3.76	0.61	45.42	7.57	0.19	18.69	3.12
Mysuru	0.66	14.79	2.47	0.04	2.76	0.46	0.13	12.50	2.08
Raichur	1.34	38.90	6.49	0.74	54.75	9.13	0.24	24.16	4.03
Ramanagar	0.76	18.18	3.03	0.58	43.30	7.22	0.57	56.78	9.46
Shivamogga	0.36	3.94	0.66	0.24	17.99	3.00	0.52	52.38	8.73
Tumakuru	1.12	31.37	5.23	0.80	59.13	9.86	0.35	34.67	5.78
Udupi	0.74	17.73	2.96	0.59	43.40	7.23	0.39	39.30	6.55
Uttara Kannada	0.56	11.06	1.84	0.50	37.23	6.21	0.87	86.60	14.44
Vijayanagara	3.05	100.00	16.67	1.35	100.00	16.67	0.38	38.26	6.38
Vijayapura	0.82	20.36	3.39	0.37	27.07	4.51	0.18	18.18	3.03
Yadgir	0.26	0.58	0.10	0.22	16.29	2.71	1.00	100.00	16.67

Source: Authors' Calculation.

3.2. Qualitative Indicator Measurement

In this analysis, each district includes three normalized metrics: the percentage of funds contributed to high-priority areas [i.e. 60% of the fund's contribution should be spent for high-priority sectors as per the guidelines (Ministry

of Mines, 2015)]. The priority areas include drinking water, health care, sanitation facilities, the welfare of women and children, welfare of the aged and disabled, education, skill development, and environmental preservation and conservation (Press Information Bureau, Government of India, 2015). Table 3 shows that 23 out of 31 districts

have spent more than 60% of the funds for the priority sectors. The spread of sanctioned funds to high-priority areas is calculated with the help of coefficient of variation. Kalaburagi is the top district for allocation of funds across different sectors of the high-priority area. In the same way, regarding the spread of the sanctioned funds to the other priority areas, Yadgir is on the top, but all the sectors of districts have zero funding; Vijaynagara performs higher in the spread of sanctioned funds to the other priority areas.

The values of the Qualitative Indicators Table 3 refer to the year 2023, sourced from the

data accessed on 15 November 2023. The colour coding indicates performance levels, with green representing high performance, white representing moderate performance, and red representing low performance. The colour differences were determined based on the normalized values for each indicator, with darker shades of green, white, and red indicating higher performance, moderate performance, and lower performance, respectively. As the colour shades fade, the values decrease, providing a clear visual representation of performance levels across districts.

Table 3: Results for Qualitative Indicators by districts in Karnataka state

District	% of Priority	Normalized (Min-Max)	Weight	*C.V of High Priority	Consistency Index	Normalized (Min-Max)	Weight	*C.V of Other Priority	Consistency Index	Normalized (Min-Max)	Weight
Bagalkot	64.2	61.6	10.3	1.4	-0.4	52.9	8.8	1.7	-0.7	4.2	0.7
Ballari	64.0	61.3	10.2	1.0	0.0	79.0	13.2	1.2	-0.2	28.1	4.7
Belagavi	75.8	74.0	12.3	1.5	-0.5	47.1	7.9	1.7	-0.7	1.7	0.3
Bengaluru (Rural)	70.3	68.1	11.4	0.7	0.3	95.4	15.9	0.9	0.1	50.0	8.3
Bengaluru (Urban)	59.2	56.2	9.4	0.9	0.1	87.3	14.6	1.5	-0.5	14.3	2.4
Bidar	56.3	53.1	8.9	1.7	-0.6	37.8	6.3	1.5	-0.5	12.2	2.0
Chamarajanagara	76.8	75.1	12.5	1.4	-0.4	53.7	9.0	0.9	0.1	45.9	7.7
Chikkaballapura	58.9	55.9	9.3	0.8	0.2	91.9	15.3	1.5	-0.5	12.9	2.2
Chikkamagaluru	70.5	68.3	11.4	1.1	-0.1	74.1	12.4	1.6	-0.6	9.5	1.6
Chitradurga	66.5	64.1	10.7	0.7	0.3	98.6	16.4	1.0	0.0	44.3	7.4
Dakshina Kannada	61.1	58.3	9.7	1.3	-0.3	61.4	10.2	1.6	-0.6	5.3	0.9
Davanagere	77.6	76.0	12.7	1.2	-0.2	66.2	11.0	1.6	-0.6	9.8	1.6
Dharwad	84.5	83.4	13.9	2.3	-1.3	0.0	0.0	1.7	-0.7	0.0	0.0
Gadag	67.9	65.5	10.9	1.1	-0.1	69.9	11.7	1.3	-0.3	22.6	3.8
Hassan	91.2	90.6	15.1	1.3	-0.3	57.8	9.6	1.6	-0.6	9.4	1.6
Haveri	60.7	57.8	9.6	1.5	-0.5	46.5	7.8	1.2	-0.2	29.5	4.9
Kalburgi	56.9	53.7	9.0	0.7	0.3	100.0	16.7	1.2	-0.2	33.0	5.5

District	% of Priority	Normalized (Min-Max)	Weight	*C.V of High Priority	Consistency Index	Normalized (Min-Max)	Weight	*C.V of Other Priority	Consistency Index	Normalized (Min-Max)	Weight
Kodagu	87.8	87.0	14.5	1.5	-0.5	44.8	7.5	1.7	-0.7	0.0	0.0
Kolar	64.4	61.8	10.3	0.8	0.2	90.5	15.1	1.7	-0.7	0.0	0.0
Koppal	45.7	41.8	7.0	1.1	-0.1	69.5	11.6	1.5	-0.5	11.7	2.0
Mandya	70.3	68.1	11.4	1.9	-0.9	24.6	4.1	1.7	-0.7	3.4	0.6
Mysuru	9.6	3.0	0.5	1.5	-0.5	45.8	7.6	1.7	-0.7	0.0	0.0
Raichur	81.9	80.6	13.4	1.0	0.0	79.4	13.2	1.7	-0.7	0.0	0.0
Ramanagar	85.8	84.8	14.1	1.2	-0.2	66.2	11.0	1.6	-0.6	6.3	1.1
Shivamogga	9.3	2.7	0.5	1.5	-0.5	47.0	7.8	1.7	-0.7	0.7	0.1
Tumakuru	89.2	88.4	14.7	1.1	-0.1	70.5	11.8	1.0	0.0	41.7	6.9
Udupi	62.7	60.0	10.0	0.8	0.2	91.9	15.3	1.0	0.0	43.4	7.2
Uttara Kannada	6.8	0.0	0.0	1.9	-0.9	23.9	4.0	1.7	-0.7	0.0	0.0
Vijayanagara	92.3	91.8	15.3	1.2	-0.2	68.1	11.4	0.7	0.4	62.5	10.4
Vijayapura	95.0	94.7	15.8	1.2	-0.2	65.4	10.9	1.7	-0.7	0.0	0.0
Yadgir	100.0	100.0	16.7	1.8	-0.8	29.1	4.9	0.0	1.0	100.0	16.7

Source: Authors.

Note: All the numerical values presented in table number 3 are rounded to one decimal place for clarity and conciseness.

3.3. DMFUI Score

Table 4 presents the DMFUI scores across the districts of Karnataka, ranking them based on the scores derived from the quantitative and qualitative indicators. These ranking answers the

research questions of how the DMFUI can be used to rank the districts of Karnataka in terms of efficiency and effectiveness in the utilization of the DMF funds and, thereby, offering us insights into the performance of the districts.

Table 4: Consolidate results: Ranking of districts by DMFUI scores in Karnataka state

District	Quantitative Total Score	Quantitative Total Score	(Quantitative + Qualitative) Total Score	Rank
Vijayanagara	39.72	37.07	76.79	1
Yadgir	19.48	38.19	57.67	2
Tumakuru	20.87	33.45	54.31	3
Bengaluru (Urban)	27.67	26.31	53.98	4

District	Quantitative Total Score	Quantitative Total Score	(Quantitative + Qualitative) Total Score	Rank
Bengaluru (Rural)	17.13	35.60	52.73	5
Hassan	24.77	26.32	51.08	6
Davanagere	25.23	25.34	50.57	7
Udupi	16.74	32.55	49.30	8
Chitradurga	14.76	34.50	49.26	9
Kalburgi	16.96	31.13	48.09	10
Chikkaballapura	19.53	26.77	46.31	11
Raichur	19.64	26.67	46.30	12
Ramanagar	19.71	26.22	45.93	13
Bagalkot	23.58	19.77	43.35	14
Ballari	14.63	28.08	42.71	15
Gadag	15.03	26.33	41.36	16
Koppal	20.60	20.49	41.10	17
Chamarajanagara	11.34	29.12	40.46	18
Chikkamagaluru	14.43	25.33	39.76	19
Dharwad	25.36	13.90	39.27	20
Vijayapura	10.94	26.69	37.62	21
Kolar	12.06	25.39	37.45	22
Dakshina Kannada	15.66	20.84	36.50	23
Belagavi	12.97	20.47	33.44	24
Haveri	10.31	22.30	32.61	25
Mandya	14.45	16.03	30.48	26
Kodagu	5.97	21.96	27.93	27
Uttara Kannada	22.48	3.98	26.47	28
Shivamogga	12.39	8.41	20.80	29
Bidar	0.00	17.19	17.19	30
Mysuru	5.01	8.13	13.14	31

Source: Authors.

Based on the composite scores, districts are ranked to identify the relative performance in utilizing DMF resources. Vijayanagara, is ranked first, indicating the most effective utilization of DMF according to the chosen indicators. This is closely followed by Yadgir and Tumakuru, who are ranked second and third, respectively, demonstrating a strong performance in DMF fund utilization. In contrast, Mysuru is ranked at the bottom, and indicates scope for improvement

in the utilization of DMF funds. This ranking system provides a framework for evaluation of DMF utilization, offering critical insights for policymakers and stakeholders. It highlights areas of excellence and potential gaps, ultimately guiding strategic decisions to enhance the DMF's effectiveness in aiding communities affected by mining activities. Further, Ballari is the top collector, and the sanctioned expenditures are highest in the DMF funds. However, from the

angle of the DMFUI index, district of Ballari stands at the 15th rank among the 31 districts of Karnataka.

We explore the relationship between the DMFUI score and the key financial metrics such

as Total collection, Sanctioned Amount, and Expense Amount by calculating the correlation coefficients. Table 5 presents the results.

Table 5: Pearson Correlation Matrix between the DMFUI score and the financial metrics in Karnataka state

	DMFUI Score	Total Collection	Sanctioned Amount	Expenses Amount
DMFUI Score	1	0.14	0.306	.359*
Sig. (2-tailed)		0.454	0.094	0.047

Source: Authors.

*significant at the 0.05 level (2-tailed)

The correlation analysis shows a nuanced relationship between the District Mineral Funds Utilization Index (DMFUI) score and the various financial metrics. A very weak positive correlation between the DMFUI score and the total collection ($r=0.14$, $p=0.454$) suggests minimal impact on the fund collection and utilization, with no statistical significance. Similarly, a weak to moderate correlation with the sanctioned amount ($r=0.306$, $p=0.094$) shows a potential relationship that lacks statistical significance, implying that the sanctioned funds do not influence the DMFUI Scores. In contrast, a moderate and statistically significant correlation with the expense amount ($r=0.359$, $p=0.047$) underlines the importance of the fund expenditure in enhancing the DMFUI score. This analysis highlights that expenditure management plays over the mere fund collection and the sanction in improving the effectiveness of the District Mineral Fund utilization for the socio-economic development in the mining-affected areas.

4. Conclusion and Policy Implication

Our findings indicate a weak positive correlation between the financial metrics and the efficacy of the DMF fund utilization. This suggests that, even though financial metrics may reflect the growth in collection, sanctioned, and expenditure

of the funds, they do not provide a reliable indicator of whether the funds are being used effectively. Moreover, it challenges the assumptions that increased financial inputs do not automatically translate into beneficial developmental outputs, underscoring the necessity for the utilization index.

Our findings have implications for the policy and the practice. That includes enhanced oversight, transparent management, and the strategic allocation of the DMF funds to address the socio-economic needs of the mining-affected communities effectively.

However, the study has its limitations. For instance, districts like Yadgir, with relatively lower financial allocation and fewer projects to implement, find it easier to implement and skewing the DMFUI rankings. Our study may not account for the scale of the project, ease of implementation, or difficulty of implementation. This is an inherent limitation of the Index.

Notwithstanding the above limitations, our study highlights the complexity of the utilization of DMF funds in Karnataka and opens up avenues for future research. Studies need to expand the foundational work of by introducing additional indicators and exploring the states to understand

the impact of the DMF funds across India. As the management and efficient utilization of funds related to natural resources remains a critical issue for the mining-rich regions, the insights provided by this study contribute to the ongoing discourse on how these resources are best harnessed for the sustainable development and well-being of affected communities.

References

- Abraham, M. (2022). India's Mining Sector: Towards a Sustainable and Equitable Future. <https://www.teriin.org/article/indias-mining-sector-towards-sustainable-and-equitable-future>
- Chadha, R., & Kapoor, I. (2022). District Mineral Foundation Funds Evaluating the Performance (Working Paper CSEP Discussion Note-10; p. 19). Centre for Social and Economic Progress (CSEP).
- Dupuy, K. E. (2016). Harnessing Natural Resources for Development: New Legal Regimes for Localized Benefit Sharing in the Mining Sector.
- Ghose, J. (2018). BENEFIT SHARING IN THE MINING SECTOR: An analysis of the role of District Mineral Foundations. The Energy and Resources Institute.
- Ministry of Mines. (2015). Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY) [ANNEXURE]. Ministry of Mines, Government of India.
- Narasimham, S., & Subbarao, D. (2018). Impact of mining on tribal socio-economic and environmental risks in India. *Economic Affairs*, 63(1), 191–202.

Annexures

Table A-1: Basic Data of DMFUI Indicator by districts in Karnataka State

(All figures are Rs. crore)

District	Collection Amount	Sanctioned Amount	Expenses Amount	No. of Projects	Completed Projects
Bagalkot	106.6	114.10	71.33	349	218.00
Ballari	1980	1594.67	576.46	1761	814.00
Belagavi	41.03	29.61	25.17	267	41.00
Bengaluru Rural	36.92	36.86	20.49	888	309.00
Bengaluru Urban	48.1	76.35	38.17	607	360.00
Bidar	1.95	0.48	0.00	9	0.00
Chamarajanagara	29.35	24.08	10.51	62	13.00
Chikkaballapura	54.73	78.03	26.09	151	60.00
Chikkamagaluru	13.31	12.32	7.03	203	47.00
Chitradurga	402.28	319.64	214.28	305	90.00
Dakshina Kannada	12.37	3.18	2.80	56	43.00
Davanagere	6.4	5.32	5.10	14	10.00
Dharwad	8.04	7.17	5.28	133	107.00
Gadag	8.99	5.07	3.82	93	44.00
Hassan	18.42	12.53	10.14	337	311.00
Haveri	6.84	7.88	1.74	122	13.00
Kalburgi	482.23	769.61	130.28	2599	871.00
Kodagu	1.61	0.73	0.49	17	1.00
Kolar	13.59	5.92	2.63	160	82.00
Koppal	61.97	88.91	39.53	466	158.00
Mandya	7.47	6.56	4.58	107	20.00
Mysuru	2.68	1.77	0.10	8	1.00
Raichur	52.58	70.23	38.86	178	43.00
Ramanagar	47.75	36.06	27.91	627	356.00
Shivamogga	3.17	1.13	0.77	21	11.00
Tumakuru	44.42	49.96	35.46	799	277.00
Udupi	12.17	9.04	7.13	257	101.00
Uttara Kannada	13.71	7.62	6.89	97	84.00
Vijayanagara	247.26	753.33	333.79	1401	536.00

Source: <https://dmft.karnataka.gov.in/Portal/Sectors> 15th November 2023.

Table A-2: Status of DMF funds priority sectors wise sanctioned amount in Karnataka State as of Nov 2023

(All figures are Rs. crore)

Districts	Drinking Water	Env Preservation	Health Care	Education	Welfare of Women and Child	The welfare of Aged and Disabled	Skill Development	Sanitation
Bagalkot	15.56	0.05	1.52	39.23	1.66	3.72	1	7.97
Ballari	383.11	16.35	194.39	248.63	62.63	10.52	25.12	79.01
Belagavi	2.02	0.2	3.79	13.29	3.09	0.01	0.01	0.03
Bengaluru (Rural)	6.46	0.84	4.1	8.24	2.48	2	1.25	1.93
Bengaluru (Urban)	4.6	3.95	5.85	11.13	3.35	0	0.5	14.62
Bidar	0.13	0.01	0	0.13	0	0	0	0
Chamarajanagara	0.72	1.63	10.18	4.28	0.45	0.3	0.14	0.8
Chikkaballapura	7.1	2.68	8.1	6.26	1.13	0.48	3.62	0.23
Chikkamagaluru	2.79	0.23	1.12	3.25	0.54	0.19	0.16	0.4
Chitradurga	33.56	33.2	38.5	63.11	15.91	5.49	10.15	12.65
Dakshina Kannada	0.14	0.33	1	0.24	0	0	0	0.24
Davanagere	1.5	0.44	0.28	1.6	0.31	0	0	0
Dharwad	0.07	0	0.65	5.24	0.1	0	0	0
Gadag	0.65	0.24	0.76	1.51	0	0	0.06	0.22
Hassan	0.41	0	1.5	5.17	0	0.04	4	0.32
Haveri	0.4	0	1.77	2.46	0	0	0	0.15
Kalburgi	38.98	22.95	30.39	48.33	10.83	9.33	5.78	60.72
Kodagu	0.09	0	0	0.36	0.2	0	0	0
Kolar	0.2	0.44	1.11	0.82	0.83	0.41	0	0
Koppal	7.79	1.21	3.66	19.27	4.79	0.65	1.98	1.28
Mandya	0.84	0	0.3	3.32	0	0	0	0.15
Mysuru	0	0	0.98	0.51	0.28	0	0	0
Raichur	6.87	0	3.77	14.68	3.97	0.78	2.5	2.75
Ramanagar	6.11	1.75	1.99	11.4	0.69	0.15	0	2.25
Shivamogga	0.06	0.03	0.06	0.6	0.04	0.04	0.04	0.1
Tumakuru	7.03	0.01	5.83	17.25	0.5	0.2	1.68	5.99
Udupi	0.61	0.08	0.8	1.81	0.24	0.45	0.51	0.52

Districts	Drinking Water	Env Preservation	Health Care	Education	Welfare of Women and Child	The welfare of Aged and Disabled	Skill Development	Sanitation
Uttara Kannada	1.56	0.45	0.7	1.36	1.07	0.31	0.2	16.2
Vijayanagara	51.34	13	160.51	134.68	27.42	4.06	10.81	0.12
Vijayapura	0.74	0.24	0.26	1.33	0.3	0	0	0
Yadgir	0	0	0.15	0.02	0	0.05	0	0
Grand Total	581.44	100.31	484.02	669.51	142.81	39.18	69.51	208.65

Source: <https://dmft.karnataka.gov.in/Portal/Sectors> data accessed on 15th November 2023.

Table A-3: Status of DMF funds other priority sectors wise sanctioned amount in Karnataka State as of November 2023

(All figures are Rs. crore)

Districts	Physical Infra	Irrigation	Energy and Work	Enhancing Environmental Quality
Bagalkot	38.26	0	0.5	0.74
Ballari	452.21	68.92	29.97	23.81
Belagavi	7.08	0.02	0.05	0.02
Bengaluru (Rural)	6.81	0	1.75	3
Bengaluru (Urban)	27.06	2	1.29	0
Bidar	0.19	0	0.02	0
Chamarajanagara	3.61	1.07	0.3	0.6
Chikkaballapura	18.66	0.13	0.5	1.39
Chikkamagaluru	3.38	0.08	0.04	0.14
Chitradurga	69.6	9.35	24.32	3.8
Dakshina Kannada	1.19	0.05	0	0
Davanagere	1.1	0	0	0.09
Dharwad	1.11	0	0	0
Gadag	1.33	0.3	0	0
Hassan	1.02	0	0	0.08
Haveri	2.39	0	0.25	0.46
Kalburgi	128.02	16.52	27.9	0

Districts	Physical Infra	Irrigation	Energy and Work	Enhancing Environmental Quality
Kodagu	0.09	0	0	0
Kolar	2.11	0	0	0
Koppal	44.01	0.99	2.75	0.53
Mandya	1.9	0	0.05	0
Mysuru	16.67	0	0	0
Raichur	7.81	0	0	0
Ramanagar	0.09	0.1	0	3.83
Shivamogga	9.4	0.02	0.03	0
Tumakuru	3.01	0	0.31	1.33
Udupi	1.98	0.46	0.05	0.5
Uttara Kannada	300.9	0	0	0
Vijayanagara	1.5	11.2	5.16	15.63
Vijayapura	0.15	0	0	0
Yadgir	0	0	0	0
Grand Total	1152.64	111.21	95.24	55.95

Source: <https://dmft.karnataka.gov.in/Portal/Sectors> 15th November 2023

Understanding Livelihood Vulnerability in Dry Regions: Insights from Karnataka

Ramesh S Kampli¹ and S.T. Bagalkoti²

Abstract

In arid regions like India, sustaining livelihoods is challenging due to climate change impacts. Rural-urban migration persists due to limited manufacturing growth and scarce rural opportunities. Vulnerability, as per Inter-governmental Panel of Climate Change, depends on sensitivity, exposure, and adaptive capacity, affecting water scarcity, food insecurity, and poverty. Adaptive capacity, influenced by education, assets, and information access, is crucial for climate adjustment. This study focuses on livelihood vulnerability in highly vulnerable districts in northern Karnataka, selecting 237 households via multi-stage proportionate random sampling, categorized by Literate Household Heads and Illiterate Household Heads. Key results of data analyses lead to policy implications, such as, enhancing literacy, crop insurance access, income diversification, increased rural development budget, and constructing vulnerability indices for targeted interventions in Karnataka state.

JEL Classification Code: Q22, R3, O130, A100

1. Introduction

Inhabitants of arid and semi-arid regions around the world, especially developing countries like India face unique challenges in sustaining their livelihoods. These regions, often characterized by limited and erratic rainfall, extreme temperatures and fragile ecosystems, are particularly vulnerable to the impacts of climate change and environmental degradation. As the global climate continues to evolve, the issue of livelihood vulnerability in dry regions has gained increasing attention from researchers and policymakers. In India, livelihood pattern is very diverse and highly connected with the natural resources due to dependency on agriculture and allied sectors. Livelihood have five capitals (assets); human capital, financial capital, physical capital, social capital and natural capital (Datta and Sharma, 2008). These capitals are interlinked each other, and give livelihood sustainability to the household or community. As a result of majority of people living in rural

area, growth of manufacturing sector is low and livelihood opportunities for them scares (Khan, 2017), they move towards cities and employed in low paid occupations.

Vulnerability is a situation of a system which easily susceptible to the uncertain happenings. Inter-governmental Panel of Climate Change (IPCC) defined vulnerability as a function of sensitivity, exposure and adaptive capacity (Rao et al., 2017). Sensitivity is the degree to which a system is affected, either adversely or beneficially by climate related stimuli. It is determined by demographic and environmental conditions of the region concerned. Exposure is the nature and degree to which system is exposed to significant climatic variations. Adaptive capacity is the ability of a system to adjust to climate change including climate variability and extremes. Adaptive capacity is determined by education, asset possession, access information, skills, management capacity etc. The vulnerability encompasses a broad range

¹ Visiting Fellow, Institute for Inclusive Growth and Development (IIGD), Dhaneshwari Nivasa, Sutagatti, Navanagara, Hubballi – 580025. E-mail: rashikam92@gmail.com

² Registrar, Haveri University, Kerimattihalli, Haveri – 581110. E-mail: stbagalkoti@yahoo.com

of interconnected factors, including but not limited to water scarcity, food insecurity, poverty and the degradation of natural resources. It reflects the complex relationship between the environment, society and economic systems in these challenging environments. Around 35 percent of the population lives in the dryland area (CIESIN, 2004 via Patnaik, 2010). Dryland is defined as situation of soil's moisture which fails to grow vegetation, and lead to low organic matter and productivity.

The review of literature (Datta and Sharma, 2008; Bhattacharjee, 2010; Rao et. al., 2017) reveals that most of the studies have focused on livelihood patterns in dry regions, drought impact on livelihoods, household conditions, especially household asset ownership, agriculture vulnerability and coping strategies. But very few have linked climate variability, livelihood vulnerability, coping up mechanisms and government intervention at the household level, especially the asset-poor households. Hence, the present study seeks to address the nature and extent of livelihood vulnerability of people in dry regions; understand the reasons for livelihood vulnerability in dry regions; and evaluate the adaptation and mitigation strategies of the households to minimize livelihood vulnerability, especially drought vulnerability between IHHs (Illiterate Headed Households) and LHHs (Literate Headed Households) in Karnataka State.

2. Methodology

Kumar et. al. (2016) note that three-fourth of the districts of northern Karnataka are categorized under very high degree of vulnerability. Therefore, the present study concentrates on northern districts of Karnataka state, particularly selected Rona taluk of Gadag district and Kushtagi taluk of Koppal district as these districts are classified as highly vulnerable districts (KSNDMC, 2017). Further, two villages for each taluk are selected for the primary data collection, namely; Lakkalakatti and Kalliganoor villages from the Rona taluk (now these villages are located in newly formed

taluk named Gajendragad) and Jahagir Gudadur and Paramanahatti villages from the Kushtagi taluk. According to respective taluk revenue officials, these villages were severely affected by the drought and many people migrated for their livelihood. The present study used multi-stage proportionate random sampling technique for selection of households in the study area and listed poor, landless, migrated, women and IHHs in each village and 16 percent of households in each village are chosen as sample households. This sample size is in proportion of rural poverty rate in 2009-10 in Karnataka State (Prabhavathi and Naveena, 2014). Thus total sample is, 237 households. By adopting lottery method, the data is collected from these households. The primary data is collected during the month of August, 2021 (Kampli, R. S., 2021)

In addition to descriptive tools, Socio-Economic Index (SEI), Integrated Livelihood Index (ILI) and Drought Vulnerability Index (DVI) are constructed using the UNDP-HDI methodology as illustrated in Annexure 1. For positively related variables, the index is calculated as $(\text{actual} - \text{minimum}) / (\text{maximum} - \text{minimum})$; for negatively related variables, it's $(\text{maximum} - \text{actual}) / (\text{maximum} - \text{minimum})$. Correlation and regression analyses are used to estimate the impact of livelihood capitals (human, financial, physical, social, and natural) on reducing vulnerability.

3. Analysis of Results

Livelihoods in an area depends on two main factors; internal and external (Datta and Sharma, 2008). Internal conditions include demographic settings which include literacy level, occupational condition, agriculture etc. Outside or external conditions include environmental condition (rainfall, temperature, land, waterbodies etc.), market condition, policies, demand condition etc. Briefly, internal conditions enable the household or the region to face any exacerbated circumstances by their own capacity. On the other hand, external conditions help farmers to withstand with

external circumstances. Hence, socio-economic conditions of the study area, adaptive capacity of the households' livelihood conditions and drought vulnerability are essential to our analysis.

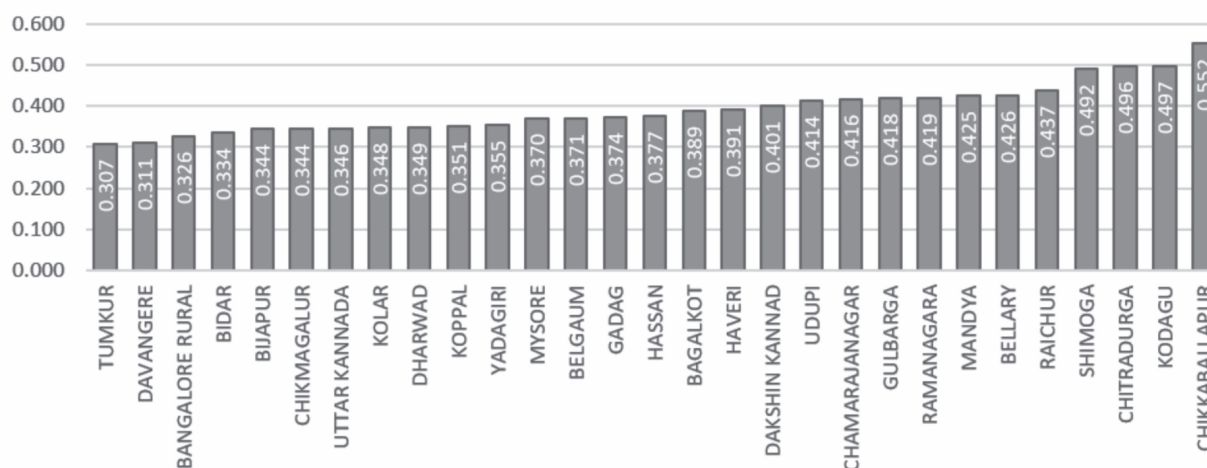
3.1. Socio-Economic Condition of the Study Area

The Figure 1 explains the Socio-Economic Index (SEI), which is constructed with key variables to reflect the socio-economic condition of the region. The essential factors encompassed in this assessment include the agricultural status of the districts, having livestock, literacy level, the composition of the working population and average rainfall experienced in each district.

The district-wise SEI of Karnataka reveals a diverse levels of development, ranging from 0.307

to 0.552. Notably, Chikkaballapur, Chitradurga, and Kodagu exhibit higher SEI values or better in socio-economic conditions, while Tumkur, Davangere and Bangalore Rural potential socio-economic challenges with lower SEI values. The varying indices emphasize the need for selective interventions and policy approaches. For instance, more than half of total districts scored less than 0.400 in SEI. Parameters like agriculture, literacy and working population are the major contributors in this index, and their poor performance contribute to lowering the score. Gadag and Koppal districts (which are selected for the primary survey) score 0.374 and 0.351 respectively, indicating that the weak socio-economic performance of the districts makes them easily susceptible to uncertainties. People in such places are vulnerable and their livelihoods are unsustainable.

Figure 1: District wise Socio-Economic Index (SEI) of Karnataka



Source: Authors' construction.

Thus, primary data collection survey is conducted in Gadag and Koppal district and 237 total sample households. Here we bifurcated the data based on condition of literacy of a family (household) head as illiterate and literate. Because a head of a family plays a vital role in decision making and influence household livelihood condition and sustainability (Vatta et al, 2017) and

leads a major role in household coping up strategy (Suan et al, 2020). Based on this reason, we explore how education of the family head influence on livelihood sustainability and withstand with the vulnerability.

Educational qualifications of household members, categorized by the literacy status of a

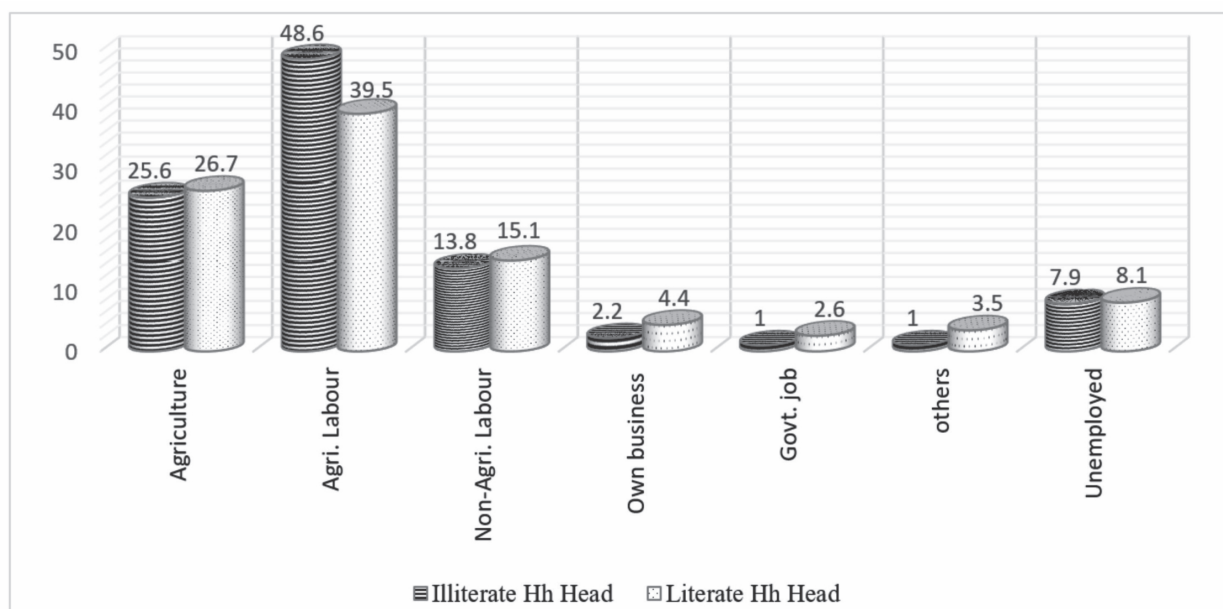
household head. It details education levels from illiterate to postgraduate and professional courses. Overall, Illiterate Household Heads (IHHs) have higher illiteracy rates. Education levels decrease as we move towards higher education. IHHs have fewer members with primary or professional education compared to Literate Household Heads (LHHs). IHHs also have fewer literate members per household. Vatta et al. (2017) note that illiterate household heads contribute to household vulnerability due to their limited decision-making capacity and awareness.

In the same way, occupational status also contributes to livelihood vulnerability. Unsustainable occupations, which are influenced by external (as well as internal) fluctuations, are easily susceptible to changes. For instance, agriculture and related works are influenced by weather-related conditions, unorganized sectors, and private businesses influenced by local

governance policies, etc. Generally, rural people are largely dependent on agriculture and related activities for their livelihoods (Gondwe, 2019), which are highly vulnerable climatically (Arora and Birwal, 2017).

In our sample, a higher number of households derive their livelihoods from agricultural labor compared to other occupations (48.6 percent for IHHs and 39.5 percent for LHHs as shown in **Figure 2**). Following agricultural labor, occupations in non-agricultural labor are the next most common. About 4 percent of households are engaged in their own businesses, and 2.6 percent have government jobs in LHHs. Approximately 8 percent of households have unemployed members in both IHHs and LHHs. This illustrates that the majority of households rely on agriculture and related activities for their livelihoods, making them more susceptible to changes in weather conditions, especially in IHHs.

Figure 2: Occupation Status of the people of sample households (in percent)



Source: Authors' calculation using data from the Field Survey.

In the same way basic household status like house condition, size, marital status, getting government facilities etc. are important to the

household sustainability. Table 1 gives basic data on household status by these indicators.

Table 1: Basic Indicators Household Status

Household status		IHHs	LHHs	Total	
% Households (Hh) having Ration card		98.4	92.6	95.8	
Average Household size (no. of members per Hh)		4.8	5.0	4.8	
% of female members		48.6	47.4	48.0	
% of Pakka Households		48.8	72.2	59.5	
Average rooms per household		2.3	2.5	2.4	
% of Households having electricity connection		Connection through Bhagya Jyoti	60.5	57.4	59.1
		Personal Connection	39.5	42.6	40.9
Cooking Fuel	% of Hh using Wood only	45.7	43.5	44.7	
	% of Hh using Gas only	10.9	9.3	10.1	
	% of Hh using both fuels	43.4	47.2	45.1	
% of Hh having Toilet facility		58.9	63.9	61.2	
Drinking Water supply	% of Hh having own tap	31.0	33.3	32.1	
	% of Hh having public tap	62.0	63.9	62.9	
	% of Hh having tanker supply	7.0	2.8	5.1	
% of Hh having home appliances (more than 3 items)		43.4	60.2	51.1	
% of Hh having Agriculture appliances		45.0	63.0	53.2	

Source: Same as Figure 2.

Table 1 compares household characteristics based on the literacy status of the household head. IHHs rely more on government subsidies, have smaller average household sizes, and fewer rooms per household. They also exhibit lower access to electricity and modern cooking fuels. In contrast, LHHs enjoy better housing conditions, larger average household sizes, more rooms per household, higher access to utilities and ownership of home and agriculture appliances. The data highlights the significant impact of literacy on socio-economic condition and household well-being, emphasizing the importance of education in improving living standards.

Knowledge and skills are vital for improving the status of individuals, households, and

communities. Skill acquisition enhances livelihoods by increasing employability, income (Harper et al., 2012), and adaptability to changing job markets. Conversely, school dropouts exacerbate livelihood vulnerability by limiting access to education and skill development, reducing job prospects and earnings, and perpetuating poverty cycles. Lack of education also hinders individuals' ability to cope with economic shocks and adapt to new technologies. Our sample highlights disparities in skill acquisition and school dropout rates, with LHHs showing higher skill acquisition and lower dropout rates compared to IHHs.

In rural areas, land ownership is crucial for securing livelihoods. It provides opportunities for agricultural activities, such as farming and

livestock rearing, which are primary sources of income for rural populations (Goldin, 2016; Vatta et al, 2017; Arora and Birwal, 2017). Additionally, land ownership offers a sense of stability and security, allowing individuals to invest in their

land for long-term sustainability. Overall, access to land plays a fundamental role in sustaining rural livelihoods and encourage economic development in these communities. **Table 2** explains land holding status of sample households.

Table 2: Nature of Land Holding (in Acre)

Land	IHHs	LHHs	Total
Average Land	2.6	3.1	2.8
% of Irrigated Land	9.3	11.6	10.5
% of Dryland	85.8	79.9	82.7
% of Fallow land	4.9	8.4	6.8
Average Land distance (in Km) from village	1.5	1.8	1.6

Source: Same as Figure 2.

The table shows that IHHs have smaller average land holdings, with a higher percentage of dryland, compared to LHHs. LHHs have a larger land holdings and more irrigated land, suggesting better access to water resources and irrigation infrastructure. LHHs also have more fallow land,

indicating strategic land management, but their land is farther from the village. Thus, addressing land access disparities and promoting sustainable practices can improve livelihoods and resilience in rural communities.

Table 3: Agriculture Production, Expenditure and Yield in Kharif and Rabi Seasons

Category	Seasons	IHHs	LHHs	Total
Average cultivated land (in acre)	In Kharif	2.2	2.3	2.3
	In Rabi	1.4	1.6	1.5
Expenditure per Acre (in Rs)	In Kharif	8,520	7,746	8,129
	In Rabi	7,158	5,747	6,418
Yield per Acre (in Quintal)	Kharif(N)	2.8	3.5	3.1
	Rabi(N)	3	2.9	2.9
	Kharif(D)	1	1.3	1.2
	Rabi(D)	1.4	1.2	1.3

Source: Same as Figure 2.

Note : N: Normal Year, D: Drought Year.

Table 3 compares agricultural production, expenditure and yield between IHHs and LHHs during Kharif and Rabi seasons. While both groups cultivate similar land sizes, IHHs incur higher expenditures (Rs. 8,520) per acre. Despite this, LHHs consistently achieve a higher yields per

acre in both normal and drought years, indicating potential advantages in farming knowledge and adaptive strategies. Addressing literacy disparities and providing support for agricultural education could help narrow productivity gaps and enhance resilience among rural households facing

climatic uncertainties, contributing to sustainable agricultural development.

On the other hand, income from agriculture and allied activities, non-agriculture laboring and own businesses are vital sources of livelihood for many households, especially in rural areas (Goldin, 2016). However, these sources of income

are vulnerable to fluctuations, such as market instability (Bhattacharjee, 2010), environmental factors and policy changes. Dependence on a single income stream can amplify vulnerability, as fluctuations in one sector can significantly impact overall income. Banerjee and Duflo (2007) argued that multiple occupations are stronger in rural area.

Table 4: Per capita (Rs) Household income per year by sources in Normal days and Drought situation

Income sources	IHHs		LHHs		Total	
	Normal days	Drought situation	Normal days	Drought situation	Normal days	Drought situation
Agriculture	3,922	1,441	4,709	1,777	4,289	1,598
Agri. Labours	11,938	2,642	9,104	1,709	10,615	2,207
Dairying	1,525	514	1,585	460	1,553	489
Non agri. Labours	3,922	2,866	3,000	2,424	3,492	2,660
Own Business	1,464	1,192	3,733	2,938	2,523	2,007
Government job	2,078	2,078	4,198	4,198	3,067	3,067
Other	276	207	1,403	1,377	802	753

Source: Same as Figure 2.

Table 4 depicts income sources among households led by illiterate and literate heads during normal days and drought situations. Agriculture remains a primary income source, with slight variations and situations. Additionally, non-agricultural labour, own businesses and government jobs contribute more or less stable household incomes. Drought situations generally lead to reduced incomes across all sectors except government and some private sector jobs. However, LHHs tend to earn more consistently across income sources compared to IHHs during both normal days and drought situations. Drought impacts on agriculture and related (agriculture labouring and dairying) incomes. Therefore, drought makes these households vulnerable.

Drought not only reduces household income but also impacts livestock, crucial for many small and marginal farmers' additional income (Arora and Birwal, 2017). During drought, feeding

livestock becomes difficult (Rurinda et al., 2014; Mphande and Annie, 2016), leading to the sale of animals as a coping strategy (Joshi, 1999). Our study shows a reduction in livestock per household, indicating asset loss due to drought.

Apart from this, the study constructs socio-economic index (SEI) based on parameters (**Table 5**) which influence socio-economic status of sample households. SEI is invaluable for households in dryland regions, where agricultural productivity and access to resources are often constrained. It enables these households to assess their economic and social status accurately, helping them identify areas for improvement and prioritize their needs. For instance, by considering indicators like per capita income, asset possession and access to irrigation, households can understand their vulnerability to drought and plan accordingly.

Table 5: Socio-Economic Index (SEI) for Households

Parameters	LHHs	IHHs
Percent of members literates in the household	0.707	0.455
Percent of members working in the household	0.590	0.612
Per capita income of the household in normal days (in Rs)	0.199	0.146
Percent of households having pakka house	0.722	0.488
Per Capita Value of Home Assets in The Household	0.163	0.181
Per Capita Value of Agriculture Assets in The Household	0.053	0.061
Percent of Households Having Tractors	0.037	0.047
Household average land holding size (in acre)	0.222	0.275
Household having irrigated land (in acre) % of irrigated land	0.151	0.096
Household having fallow land (in acre) % of fallow land*	0.947	0.985
Percent of members having various accounts	0.986	0.961
Per capita value of livestock	0.212	0.198
Percent of households having electricity	1.000	1.000
Percent of Hhs having Toilets	0.639	0.589
Average Distance of field of household from village (in km) *	0.853	0.765
Percent of members in household working in non-agriculture sector	0.481	0.434
Percent of members in household working in salaried job	0.083	0.031
Percent of Unemployed members in Hhs*	0.741	0.752
Percent of Households having membership in any social groups	0.000	0.008
Per capita loan taken by Hhs (loan per Member) *	0.165	0.127
Socio-Economic Index	0.447	0.411

Source: Same as Figure 2.

* These parameters are negatively related with SEI.

The table 5 provides a comprehensive overview of how literacy influences various socio-economic parameters, as reflected in the SEI. Comparing households with literate and illiterate heads, LHHs consistently exhibit higher SEI scores (0.447). They boast better education levels, reflected in higher literacy rates among members, and higher rates of employment in non-agricultural sectors and salaried jobs. This translates into higher per capita income and greater ownership of assets, including homes and agriculture assets. Moreover, LHHs have superior access to basic amenities like pucca houses, electricity, and toilets, indicating a higher standard of living. They also demonstrate a more active participation in financial systems,

with higher percentages of members having various accounts.

These findings highlight the critical role of literacy of household head in shaping socio-economic outcomes, highlighting the importance of education as a catalyst for improving overall well-being and fostering less vulnerable within communities. On the other hand, IHHs scored 0.411 in SEI which is due to less irrigated land, per capita income, literates in the household etc. Overall, both households (LHHs and IHHs) scored less than 0.500 indicating that asset possession is poor in these households and highly vulnerable to the unexpected shocks in the system (Sahu, 2018) and their livelihoods become unsustainable.

3.2. Adaptive Capacity and Livelihood Conditions of the study Area

Households particularly in dryland employ adaptive strategies (Angels et al, 2011; Patnaik, 2010; Rao et al, 2017) to sustain livelihoods amidst uncertainties, which is defined as an ability of the system to withstand (or even adjust) with the uncertainty (Rao et al, 2017). These strategies are vital for mitigating risks posed by factors like drought, water scarcity and soil degradation, ensuring food security and economic stability.

By diversifying income sources, conserving resources and encourage community cooperation, households enhance resilience, enabling them to withstand environmental challenges and maintain sustainable livelihoods in severe conditions. Table 6 provides important insight about adaptive capacity of the sample households, where we can notice that Adaptive Capacity Index (ACI) is higher for LHHs than the IHHs which demonstrate literacy plays a significant role in adaptive capacity.

Table 6: Adaptive Capacity Index (ACI) of the Sample Households

Parameters	LHHs	IHHs
Percent of Hhs having literate household head	1.000	0.000
Percent of Hhs members having vocational education (ITI, Diploma etc.)	0.231	0.101
Percent of working members in the household	0.590	0.612
Percent of non-agriculture workers	0.097	0.091
percent of Hhs heard about climate change	0.769	0.744
Percent of Hhs having information about drought before its occurrence	0.352	0.357
Percent of Hhs reduce cultivation land	0.389	0.318
Percent of Hhs use less water intensive crops	0.259	0.225
Percent of Hhs change sowing time	0.287	0.256
Percent of Hhs interest in mixed farming	0.250	0.240
Percent of Hhs construct farm ponds	0.139	0.124
Percent of Hhs taken crop insurance	0.574	0.434
Percent of Hhs start non-agriculture activities	0.694	0.705
Percent of Hhs postponed household functions	0.657	0.721
Percent of Hhs work in MGNREGs during drought	0.722	0.767
Percent of Hhs reported migration during drought situation	0.611	0.597
Percent of Hhs having any social securities	0.963	0.992
Percent of Hhs using old savings	0.796	0.899
ACI	0.521	0.455

Source: Same as Figure 2.

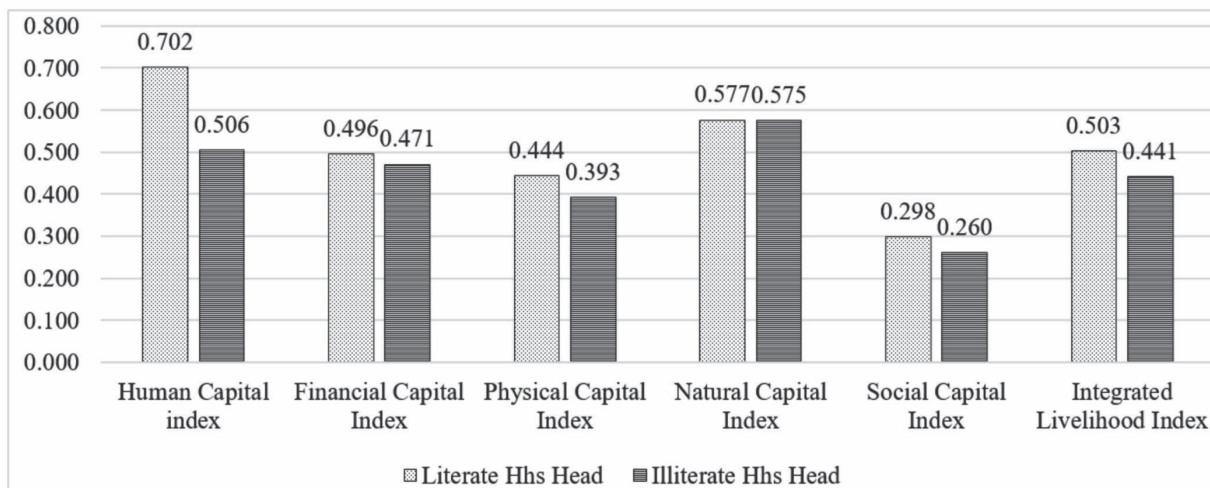
LHHs demonstrate good adaptability across parameters, boasting higher levels of awareness, education and engage in non-agricultural activities. They exhibit proactive measures such

as taking vocational training, crop insurance adoption and land use adjustments (Patnaik, 2010). In contrast, IHHs rely more on traditional coping up mechanisms. Strengthening literacy

and education efforts can substantially strengthen adaptive capacity, ensuring households are better equipped to navigate climate-induced adversities and fostering resilience in vulnerable communities. Adaptive capacity is determined by asset possession (Vatta et al., 2017) of the households, which according to Rao et al., (2017), is a function

of wealth, technology, education, information, skills, infrastructure, access to resources, stability and management capabilities. These livelihood capitals make household withstand with the uncertainty. The figure 3 displays Integrated Livelihood Index (ILI) based on five capitals.

Figure 3: Integrated Livelihood Index (ILI)

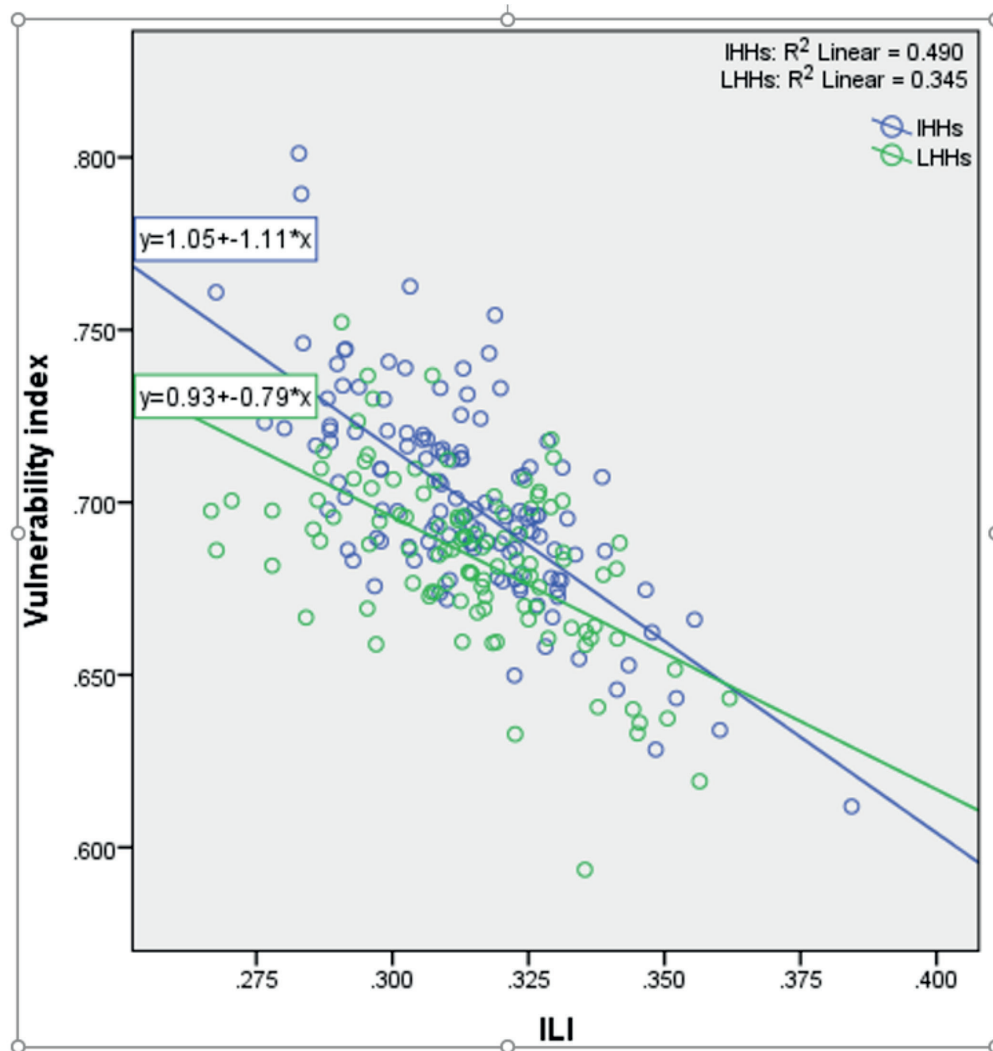


Source: Same as Figure 2.

The figure compares ILI between LHHs and IHHs across various capitals. LHHs generally exhibit higher indices, indicating education's positive influence on livelihood. This trend is consistent across human, financial, physical and social capitals, suggesting literacy raises better access to resources and networks. However, both groups show similar levels of integrated livelihood concerning natural capital, implying its universal impact irrespective of literacy level of household head. Overall, compared to LHHs, ILI is lower for

IHHs, illustrating that livelihood opportunities are more for well-trained, educated individuals than for those lacking these skills. This highlights the relationship between household livelihood and vulnerability (Figure 4), which reveals a negative correlation. Figure 4 indicates that improvements in livelihood factors tend to reduce vulnerability. As livelihoods strengthen, vulnerability decreases, signifying increased resilience to adverse circumstances.

Figure 4: Relationship between Livelihood and Vulnerability



Source: Calculated by Authors.

But this relationship varies between IHHs and LHHs where the trend lines intercepts and slopes are different. The intercept of IHHs trend line indicate that without livelihoods (0), their vulnerability is expected to be 1.05 which is higher than that of LHHs intercept (0.93). on the other hand, the vulnerability decreases more steeply with increasing livelihood for IHHs (-1.11) compared to LHHs (-0.79). This express that improvements in livelihood factors have a greater impact on reducing vulnerability for IHHs and initially, LHHs tend to have lower vulnerability than IHHs when livelihood factors are at their lowest.

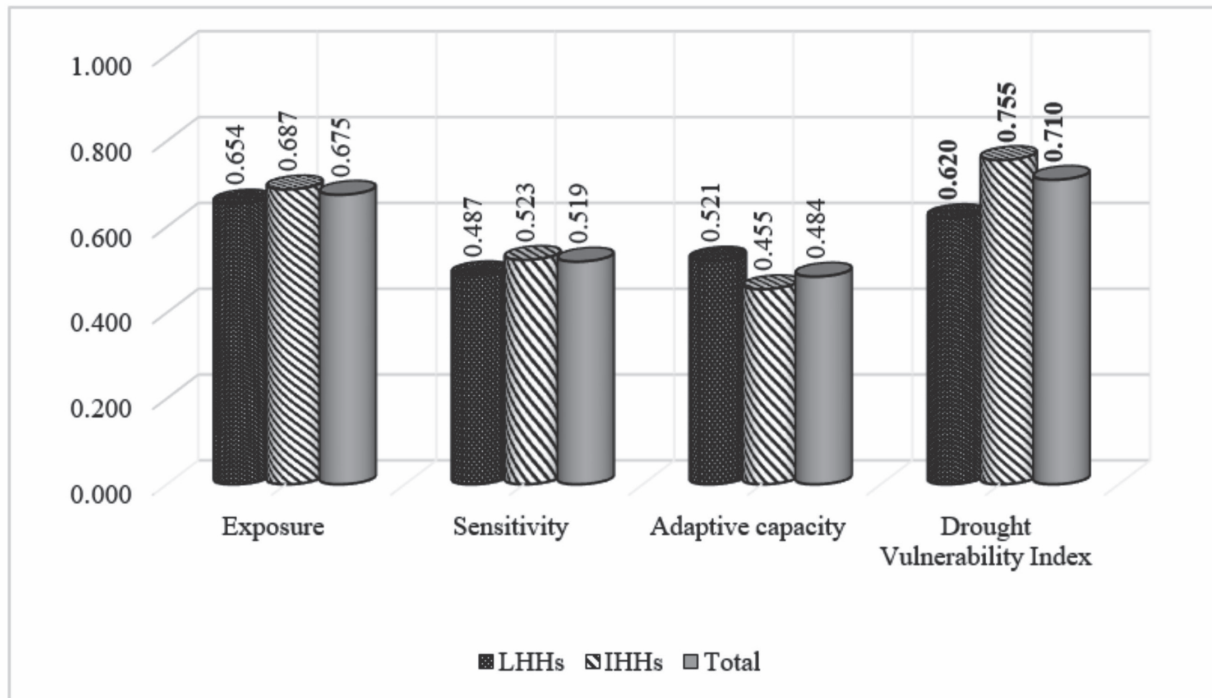
3.3. Drought Vulnerability

Drought vulnerability in Karnataka is a pressing issue, intensified by erratic rainfall, water depletion, deforestation and climate change. This vulnerability disproportionately affects rural areas, where agriculture is a primary source of livelihood. Farmers face crop failures, reduced yields and financial stress, while livestock suffer from water scarcity and fodder shortages. Rural communities bear water stress, impacting daily life and livelihood. Migration to urban areas in search of employment (Goldin, 2016) becomes a necessity, further straining social and economic structures. Thus, assessing vulnerability is crucial

for rural dryland area to mitigate effects of such uncertainty. Here an attempt is made (in the Figure 5) to analyze impact of drought on household vulnerability through a Drought Vulnerability Index (DVI). It involves computation of Exposure

Index (EI),³ Sensitivity Index (SI)⁴ and Adaptive Capacity Index (ACI); and amalgamating these three into a single composite index called the DVI (Singh and Hiremath, 2008; Panda, 2013).

Figure 5: Drought Vulnerability Index (DVI)



Source: Calculated by Authors.

This figure presents a comparative analysis of the DVI among LHHs and IHHs. Notably, IHHs exhibit a higher vulnerability with a DVI of 0.755 compared to LHHs at 0.620. This suggests a correlation between education level and resilience to drought. Additionally, exposure and sensitivity scores align with this trend, showcasing higher values for IHHs, which indicate that compared to LHHs, IHHs possess less assets (livelihood capitals) and these two parameters positively associated with vulnerability. But overall, the data underscores that vulnerability is highest regardless of any category at 0.710 which is due to

lack of asset possession and weak environmental conditions (dryness, less rainfall, high temperature etc.)

3.4. Regression Analysis

Estimated the determinants of Livelihood Vulnerability Index (LVI) with independent variables like human capital, financial capital, physical capital, natural capital, and social capital and model found to be statistically significant at 0.01 level. The results are given in Table 7 and Table 8 below.

³ Exposure is the nature and degree to which a system is exposed to significant climate variations.

⁴ Sensitivity is the status of an assetlessness of households (Rao et al, 2017; Noghri et al, 2016). It is the system which affect livelihood, either positively or negatively.

Table 7: Determinants of Livelihood Vulnerability for IHHs – Estimates of Multiple Regression Model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)*	1.529	0.122		12.535	0.000		
Human Capital	-1.065	0.444	-0.102	-2.398	0.018	0.948	1.054
Financial Capital	-0.476	0.032	-0.655	-14.856	0.000	0.876	1.141
Physical Capital	-2.272	0.434	-0.235	-5.231	0.000	0.842	1.187
Natural Capital	-0.139	0.031	-0.202	-4.491	0.000	0.838	1.193
Social Capital	-1.370	0.506	-0.114	-2.708	0.008	0.964	1.038
R	R Square		Adjusted R Square		Durbin-Watson		
	0.889		0.791		0.782	1.795	

Source: Calculated by Authors.

* Dependent Variable is Livelihood Vulnerability Index (LVI).

Additionally, there are no autocorrelation issues detected in these models, as indicated by the Durbin-Watson test of 1.79 and 2.04 for IHHs and LHHs, respectively. Furthermore, the variance inflation factor (VIF) values suggest the

absence of multicollinearity problems among the independent variables. With R² values of 0.79 and 0.72 for both models, it is evident that a significant percentage of the dependent variable (LVI) can be explained by the independent variables.

Table 8: Determinants of Livelihood Vulnerability for LHHs –Estimates of Multiple Regression Model

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)*	1.145	0.108		10.572	0.000		
Human Capital	-1.129	0.393	-0.164	-2.875	0.005	0.843	1.186
Financial Capital	-0.406	0.039	-0.59	-10.435	0.000	0.859	1.163
Physical Capital	-1.013	0.377	-0.15	-2.684	0.008	0.882	1.133
Natural Capital	-0.177	0.033	-0.309	-5.308	0.000	0.812	1.231
Social Capital	-0.562	0.543	-0.058	-1.035	0.303	0.872	1.147
R	R Square		Adjusted R Square		Durbin-Watson		
	0.849		0.720		0.706	2.048	

Source: Calculated by Authors.

* Dependent Variable is Livelihood Vulnerability Index (LVI).

A comparison of the regression results for IHHs and LHHs reveals distinct determinants of livelihood vulnerability. Physical capital, encompassing productive assets, significantly affects vulnerability. A one percent increase in physical assets reduces vulnerability by 2.27 percent for IHHs, compared to 1.01 percent for LHHs. Similarly, a one percent increase in human capital (reflecting education and health) results in vulnerability reductions of 1.12 percent for LHHs and 1.06 percent for IHHs. Financial capital emerges as influential for both groups. Natural capital's effect appears slightly higher for LHHs. Social capital notably reduces vulnerability for IHHs but less so for LHHs, indicating a greater reliance on social networks for IHHs. Overall, the models suggest that physical and social capital significantly contribute to reducing vulnerability for IHHs, while human and natural capital play a more prominent role in vulnerability reduction for LHHs.

3.5. Government Support

Government (central and state) has designed a number of interventions to help the vulnerable people to overcome the immediate stress, or to overcome the general poverty. Through targeted initiatives, such as livelihood training programs, access to microfinance and skill development schemes, the government aims to empower individuals to create sustainable livelihoods. Additionally, welfare schemes offering food security, healthcare and housing assistance ensure basic needs are met. By encourage community resilience and socio-economic development, these efforts strive to uplift vulnerable populations and mitigate the impact of environmental challenges in Karnataka's dry regions. We collected primary data by asking the sample households about the nature of central and state government schemes accessed (shows in the **Table 9**).

Table 9: Percentage of Households Availing Benefits from the Government Schemes

Schemes	IHHs	LHHs	Total
Old age pension	39.5	42.6	40.9
Disabled pension	7.8	8.3	8.0
Widow pension	15.5	8.3	12.2
MGNREGA	76.7	72.2	74.7
Housing scheme	17.1	5.6	11.8
Crop Insurance	33.3	46.3	39.2
Annabhagya Yojana	96.1	90.7	93.7
Kisan Samman Nidhi	30.2	42.6	35.9
Ayushman Bharat Yojana	22.5	21.3	21.9
Rashtriya Swasthya Bhima yojana	9.3	10.2	9.7

Source: Same as Figure 2.

The table illustrates that IHHs have higher participation rates across most schemes, indicating potentially greater dependence on government support. Schemes like Annabhagya Yojana and MGNREGA exhibit notably high participation among both groups, emphasizing their importance in providing food security and employment

opportunities. However, LHHs show higher participation in schemes such as Crop Insurance and Kisan Samman Nidhi, reflecting their likely engagement in agricultural activities and use government benefits. Overall, the data highlights the diverse support mechanisms provided by the government to address the needs of vulnerable

households. But since government schemes come as post-facto schemes, i.e., after the risk situation hit the regions (Choudhury and Sindhi, 2017; Jadhav, 2019), poor people may not be able to sustain their livelihoods.

4. Conclusion and Implications

Livelihood vulnerability in dry area of Karnataka exacerbated by climate related factors like erratic rainfall, water scarcity, temperature increase, flood etc. and socio-economic conditions of an area where the agriculture is predominating livelihood, where most of the land relies on rainfall. The reliance on rain-fed agriculture makes communities particularly susceptible to climate variability, leading to economic instability and food insecurity. Adaptive strategies, such as sustainable water management, diversification of income sources and government support programs, are essential to mitigate these vulnerabilities. Addressing these challenges requires a coordinated effort to enhance resilience, ensuring sustainable livelihoods and improving the socio-economic conditions of the affected populations in Karnataka.

In our sample, many households found livelihoods through agricultural laboring, followed by agricultural and non-agricultural labor. LHHs generally enjoy better living conditions, access to sanitation, pukka homes, agricultural appliances, and more permanent housing compared to IHHs. These differences underscore the critical role of literacy in enhancing socio-economic status and resource access. Additionally, LHHs possess more agricultural land with higher proportions of irrigated land compared to IHHs. The impact of drought is more severe on dryland compared to irrigated land, which is reflected in the quantity of agricultural production. LHHs generally have higher literacy rates, income, non-agricultural employment, home assets, and participation in social groups, contributing to their highest SEI. However, overall, SEI indicates that the sample households are socio-economically poor.

LHHs also show higher adaptive capacities with better vocational education, crop insurance uptake, and climate change awareness. They employ more agricultural adaptation strategies. In contrast, IHHs rely more on social securities and old savings and participate more in MGNREGS during droughts. Overall, LHHs demonstrate stronger resilience compared to IHHs. LHHs score higher in most livelihood capitals, highlighting the benefits of education, while natural capital impacts both groups equally. It is clear that access to livelihood capitals reduces household vulnerability. Physical capital and social capital are crucial for reducing livelihood vulnerability among IHHs, while human capital contributes more for LHHs. LHHs benefit more from crop insurance and Kisan Samman Nidhi, indicating better resource access. IHHs rely more on MGNREGA and housing schemes, indicating higher dependency. Widow pension uptake is notably higher for IHHs. Both groups use Annabhagya Yojana extensively. However, further policy efforts are needed to enhance literacy with adult education and vocational training, improve access to crop insurance and irrigation to mitigate drought impacts, strengthen social securities and diversify income sources through non-agricultural employment, increase budgetary support for rural development, irrigation and flood control and promote participation in social groups to build community resilience. These are some common policy suggestions, but more than these, constructing a livelihood vulnerability index, drought vulnerability index, and socio-economic index at the district level is crucial. This would help policymakers concentrate on targeted areas to mitigate such vulnerabilities.

References

Angels S., M. Chinnaduri and A. Sundar (2011). Awareness on Impact of Climate Change on Dryland Agriculture and Coping Mechanisms of Dryland Farmers. *Indian Journal of Agricultural Economics*, Vol. 66. No. 3. July-Sept. 2011.

Arora Anchal and Devesh Birwal (2017). Natural calamities, Crop losses and Coping Strategies: An Economic Analysis from Odisha. *Indian Journal of Agricultural Economics*, Vol. 72. No. 3, July-Sept 2017.

Bhattacharjee Mahua (2010). A Comparative Study of Livelihood Strategies in Rural and Urban Assam. *The Indian journal of social work*, Volume 71, Issue 3, July 2010.

Choudhury Pranab Rajan, Sumita Sindhi (2017). Improving the drought Resilient of the Small Farmer Agro system. *Economic and Political weekly*, Vol. LII No. 32, August 12, 2017.

Datta Shankar, Vipin Sharma (2008). State of India's Livelihoods: the 4P Report. ACCESS Development services; 28 Hauz, villages, New Delhi: 110016.

Goldin Ian (2016). *The Pursuit of Development: Economic Growth, Social Change and Ideas*. OXFORD University press, great clarendon street, Oxford OX 26 DP, U.K 2016.

Gondwe Grace (2019). Reducing Vulnerability of the Rural Poor Through Adaptation and Mitigation. written for the Expert Group Meeting on Eradicating Rural Poverty to Implement the 2030 Agenda for Sustainable Development, Addis Ababa, 27 February – 1 March 2019.

Harper Malcolen, Lalitha Iyer and Jane Rosser (2012). *Whose sustainability counts?* New Delhi, 2012, Sage publications.

Jadhav Radheshyam (2019). Why India struggles to cope with Droughts. *Business Line*, RRA Newsletters, May 06, 2019.

Khan Khursheed Ahmad (2017). Regional Dimensions in crisis of Agriculture: A case study of Uttar Pradesh. *Indian Journal of Agricultural Economics*, Vol. 72. No. 3, July-Sept 2017.

KSNDMC, (2017). Drought Vulnerability Assessment in Karnataka. Karnataka State Natural Disaster Monitoring Centre (KSNDMC), Department of Revenue, Government of Karnataka, Bengaluru, January, 2017.

Kumar Suresh, A. Raizada, H. Biswas, S. Srinivas and B. Mondal (2016). Assessment of Vulnerability to climate change: A case study of Karnataka. *Indian Journal of Soil Conservation*, Vol. 44. No. 3. Pp 314-320.

Mphande and Fingani Annie (2016). Infectious Diseases and rural livelihood in developing countries, (chapter-2, Rural livelihood). Springer Science + Business Media, Singapore, 2016.

Nongbri Baiarbor, S.M. Feroze, Lala I.P. Ray and L. Devarani (2016). Assessment of risk due to exposure to drought, a study of farm households of Nagaland. *Indian Journal of Agricultural Economics*, Vol. 71, No. 3, July – Sep. 2016.

Panda Architesh (2013). Climate Induced Vulnerability and Adaptation by Rural Households: A Study of Some Drought Prone Districts in Orissa. Institute for Social and Economic Change, Bengaluru, February, 2013.

Patnaik Itishree (2010). Distress situation in Dryland Areas Impact on Livelihood Pattern and the coping Strategies: A Review. Research Unit for Livelihoods and Natural Resources and Centre for Economic and Social Studies, Begumpet, Hyderabad.

Rao Rama C.A., B.M.K. Raju, A.V.M. Subba Rao, K.V. Rao, Josily Samuel, Kausalya Ramachandran, K. Nagasree, R. Nagarjuna Kumar and K. Ravi Shankar (2017). Assessing vulnerability and adaptation of Agriculture to Climate Change in Andhra Pradesh. *Indian Journal of Agricultural Economics*, Vol. 72, No. 3, July – Sept 2017.

Rurinda J., P. Mapfumo, M.T. van Wijk, F. Mtambanengwe, M.C. Rufino, R. Chikowo, K.E. Giller (2014). Sources of vulnerability to a variable and changing climate among smallholder households in Zimbabwe: A participatory analysis. *Climate Risk Management* (2014), www.elsevier.com/locate/crm

Sahu Basanta (2018). Household Drought Coping Food Insecurity and Women in Odisha. *Economic and Political Weekly*, Vol LIII No, 17. April 28, 2018.

Singh Pramod K. and B.N. Hiremath (2008). Sustainable livelihood security index in Gujarat: A district level illustration. Institute of rural management Anand, Gujrat, March 2008.

Suan Sam Anu, Subash Surendran Padmaja, Harald Kachele, Ranjit Kumar and Klaus Muller (2020). Climate change, drought and rural communities: Understanding people's perceptions and adaptations in rural eastern India. *International Journal of Disaster Risk Reduction*, Volume 44, April 2020, 101436.

Vatta Kamal, Parish Budhiraja and Sandheep Dixit (2017). Vulnerability of Tribal rural Households in India: Measuring Current Status, Risks of Climate Shocks and Impact of Potential Interventions for Improving Rural Livelihoods. *Indian Journal of Agriculture Economics*, Vol. 72, No. 3, July – Sept 2017

Annexure 1: Calculation of SEI

Sl. No	Variables	Nature of variable	Actual	Maximum	Minimum	Actual-minimum	Maximum-Minimum	Index
1	Percent of members literates in the household	Positive	70.7	100	0	71	100	0.707
2	Percent of members working in the household	Positive	59.0	100	0	59	100	0.590
3	Per capita income of the Hhs from various activities in normal days (in Rs) (per Hhs)	Positive	137627	589000	25500	112127	563500	0.199
4	Percent of households having pakka house	Positive	72.2	100	0	72	100	0.722
5	Per capita Value of Home assets in the Household (per Hh)	Positive	53088	274500	10000	43088	264500	0.163
6	Per capita value of agriculture assets in the household (per Hh)	Positive	58426	1105000	0	58426	1105000	0.053
7	Percent of Households Having Tractors	Positive	3.7	100	0	4	100	0.037
8	Household average land holding size (in acre)	Positive	3.1	12	0.5	3	12	0.222
9	Household having irrigated land (in acre) % of irrigated land	Positive	15.1	100	0	15	100	0.151
10	Household having fallow land (in acre) % of fallow land	Negative	5.3	100	0	94.7*	100	0.947
11	% of members having various accounts	Positive	99	100	0	99	100	0.986
12	Per capita value of livestock (per Hhs)	Positive	10575	50000	0	10575	50000	0.212
13	Percent of households having electricity	Positive	100	100	0	100	100	1.000
14	Percent of Hhs having Toilets	Positive	63.9	100	0	64	100	0.639
15	Average Distance of field of household from village (in km)	Negative	1.3	9	0	7.7*	9	0.853
16	Percent of members in household working in non-agriculture sector	Positive	48.1	100	0	48	100	0.481
17	Percent of members in household working in salaried job	Positive	8.3	100	0	8	100	0.083
18	Percent of Unemployed members in Hhs	Negative	25.9	100	0	74.1*	100	0.741
19	Percent of Households having membership in any social groups	Positive	0.0	100	0	0	100	0.000
20	Per capita loan taken by Hhs (loan per Hhs)	Negative	122120	740000	0	122120*	740000	0.165
Socio-economic Index for LHHs								0.447

Source: Authors.

*Maximum-Actual.

State Financial Corporations and Development of MSMEs – A Case Study of Karnataka State Financial Corporation

Dileep Kumar S D¹

Abstract

Micro, Small, and Medium Enterprises (MSMEs) have been pivotal in driving the economy's development, not only in the local context but also globally. However, despite their significant contributions, these enterprises often face obstacles that prevent them from fully leveraging their resources for further economic development. Among these challenges, financial resources stand out as a predominant issue. As a result, many MSMEs experience declining profits or struggle with increasing losses. Consequently, state financial corporations, such as, the Karnataka State Financial Corporation, have emerged as a crucial solution to the financial woes of MSMEs, offering substantial relief and support. In this background, this study attempts to examine the performance of the corporation and its impact on the development of MSMEs in the state. For this purpose, operational statistics of the corporation for a period of 10 years, 2013-14 to 2022-23, are collected and used.

JEL Classification Codes: L25, O16, O17, O47

1. Introduction

Micro, Small & Medium Enterprises (MSMEs) are instrumental in nurturing entrepreneurship and fostering innovation within the business landscape. These enterprises are expanding their footprint across diverse sectors, offering a broad spectrum of products and services tailored for both domestic and international markets. In India, MSMEs play a vital role in generating employment opportunities while requiring lower capital investments compared to large-scale industries. Additionally, they contribute to the industrial development of rural and underdeveloped areas, thus alleviating regional inequalities and promoting a more balanced distribution of national income and wealth. According to the National Sample Survey (NSS) 73rd round conducted during 2015-16 by the National Sample Survey Office, Ministry of Statistics & Programme Implementation, the country boasted approximately 633.88

lakh unincorporated non-agricultural MSMEs engaging in various economic activities, including manufacturing, trade, and other services.

The Micro sector, encompassing around 630.52 lakh enterprises, represents more than 99% of the total estimated MSMEs. In comparison, the Small sector, comprising 3.31 lakh enterprises, and the Medium sector, with 0.05 lakh enterprises, make up 0.52% and 0.01% of the total estimated MSMEs, respectively. Out of the 633.88 lakh estimated MSMEs, 324.88 lakh (51.25%) operate in rural areas, while 309 lakh (48.75%) are located in urban areas. Among these, 608.41 lakh (95.98%) are proprietary concerns, with a significant predominance of male ownership, constituting 79.63% of enterprises, compared to 20.37% owned by females. This ownership trend remains consistent across both urban and rural areas, with male-owned enterprises slightly more prevalent in urban settings (81.58% versus 77.76%

¹ Assistant Professor, PES Institute of Advanced Management Studies, Shivamogga, Karnataka-577204.
E-mail: dileepd87@gmail.com

in rural areas). Socially disadvantaged groups own nearly 66.27% of MSMEs, predominantly by Other Backward Classes (OBCs) at 49.72%. The representation of Scheduled Castes (SC) and Scheduled Tribes (ST) owners in the MSME sector is relatively low, at 12.45% and 4.10%, respectively. In rural areas, about 73.67% of MSMEs are owned by socially disadvantaged groups, with OBCs constituting 51.59%. In urban areas, approximately 58.68% belong to socially disadvantaged groups, with OBCs comprising 47.80%. Furthermore, an analysis of enterprises owned by socially disadvantaged groups across the three segments of the MSME sector reveals that the Micro sector has 66.42% of enterprises owned by socially disadvantaged groups, while the Small and Medium sectors have 36.80% and 24.94% of enterprises owned by socially disadvantaged groups, respectively.

Additionally, as per the National Sample Survey (NSS) 73rd round conducted during the 2015-16 period, the MSME sector has been instrumental in generating 11.10 crore jobs (360.41 lakh in Manufacturing, 0.07 lakh in Non-captive Electricity Generation and Transmission, 387.18 lakh in Trade, and 362.82 lakh in Other Services) across rural and urban areas in the country. The Micro sector, comprising approximately 630.52 lakh enterprises, contributed to employing 1076.19 lakh individuals, accounting for about 97% of total sector employment. In contrast, the Small sector, with 3.31 lakh enterprises, and the Medium sector, with 0.05 lakh enterprises, employed 31.95 lakh (2.88%) and 1.75 lakh (0.16%) individuals, respectively, of the total employment in the MSME sector. Out of 1109.89 lakh employees in the MSME sector, 844.68 lakh (76%) are male, while the remaining 264.92 lakh (24%) are female.

Despite their significant contributions, MSMEs face numerous challenges, with financial hurdles being particularly prominent. These challenges include issues like insufficient and delayed access to credit, high credit costs, strict

collateral requirements, and limited availability of equity capital. Financial constraints pose a significant obstacle for over 1.1 crore MSMEs in the nation, constituting around 90% of industrial units. In response to the plight of MSMEs, both the Government of India and state governments have taken proactive steps to address these issues by establishing specialized financial institutions offering medium and long-term credit. These institutions cater to the needs of MSMEs that may not be adequately served by traditional commercial banks. Consequently, various industrial development financial institutions have been established nationwide, such as the Industrial Development Bank of India (IDBI), Industrial Credit and Investment Corporation of India (ICICI), and Industrial Finance Corporation of India (IFCI), among others. At the state level, entities like State Financial Corporations have been set up to address regional requirements. An excellent example is the Karnataka State Financial Corporation established by the Karnataka State Government (GoK). This corporation provides a range of financial services, including medium and long-term loans/advances tailored to the needs of MSMEs operating in the state of Karnataka.

2. State Financial Corporations – An Overview

In India, State Financial Corporations (SFCs) play a vital role in nurturing industrial development and fostering entrepreneurship by extending financial support to small and medium-sized enterprises (SMEs). Established under the State Financial Corporations Act of 1951, SFCs operate at the state level and serve as a crucial link between conventional banking institutions and the unique needs of SMEs. A key function of SFCs is to provide long-term financial aid to SMEs for establishing new ventures, modernizing existing units, or expanding their operations. This support typically includes term loans, working capital assistance, and equipment financing, tailored to address the diverse requirements of various industries.

SFCs also extend various advisory services to entrepreneurs, including assistance with project feasibility studies, market research, and business planning. By providing these services, SFCs help entrepreneurs make informed decisions and enhance the viability of their projects. Additionally, SFCs act as catalysts for regional development by promoting industrial growth in economically backward areas. They prioritize funding for projects located in such regions, thereby stimulating economic activity, creating employment opportunities, and reducing regional disparities. Moreover, SFCs facilitate the rehabilitation of sick industrial units by restructuring their debt and providing financial and managerial assistance. This intervention helps revive struggling enterprises, safeguarding investments and preserving employment.

In recent years, SFCs have evolved to adapt to changing economic dynamics and emerging challenges. They have embraced technology to streamline their operations, improve efficiency, and enhance customer service. Besides, SFCs have diversified their product offerings to include innovative financing solutions such as venture capital, leasing, and factoring, catering to the evolving needs of SMEs. Overall, State Financial Corporations in India serve as vital pillars of support for SMEs, fostering entrepreneurship, driving industrial growth, and contributing to economic development at both the state and national levels.

3. Karnataka State Financial Corporation

Established on March 30, 1959, the Karnataka State Financial Corporation (KSFC) stands as a prominent state-level financial institution formed under Section 3 of the State Financial Corporations Act, 1951. Originally known as the Mysore State Financial Corporation until November 1, 1973, KSFC is predominantly owned by the Government of Karnataka, holding a majority stake of 94.13%.

Other stakeholders include SIDBI (5.83%) and various entities such as insurance companies, public sector banks, cooperative societies, and banks (0.04%). With operations spanning the entire state, KSFC has structured its activities into four circles, supported by seven zonal offices and 30 branch offices. These strategically located branch offices, including multiple ones in Bengaluru, underscore KSFC's extensive reach and commitment to meeting the financial requirements of businesses across Karnataka.

The primary mission of KSFC is to address the medium- and long-term financial needs of MSMEs within the state. Over its 64-year journey, KSFC has significantly expanded its role as a responsive financial institution. Through ongoing re-engineering efforts, it has evolved to ensure customer satisfaction by introducing new schemes, strategies, and enhancing transparency. The corporation has played a crucial role in facilitating the establishment and growth of MSMEs, fostering development in industrially underserved regions of the state, and nurturing first-generation entrepreneurs. Initially concentrated on providing loans to business entities, KSFC has progressed over the years to offer a diverse array of financial aid, encompassing short, medium, and long-term loans, lease finance, hire purchase finance, merchant banking, and financial services. Additionally, it provides financial assistance to a broad spectrum of units spanning both manufacturing and service sectors. Signs of its expansion and advancement include the growing number of supported business units, the volume of sanctioned and disbursed loans, as well as loan recoveries. Since its establishment, KSFC has facilitated financial aid to around 1,75,833 industrial units, amounting to 19,680.73 crores, with over 60% earmarked for MSMEs.

The financial performance of Karnataka State Financial Corporation (KSFC) can be assessed based on its current ratio and debt equity ratio

for the study period. The current ratio measures KSFC's ability to cover its short-term liabilities with its short-term assets. A current ratio below 1.0 indicates that the corporation may have difficulty meeting its short-term obligations. Comparing the current ratio for March 31, 2023 (0.184) with that of March 31, 2014 (0.9478), there seems to have been a significant decrease over time. This decline suggests a potential deterioration in KSFC's liquidity position, which may raise concerns about its ability to manage short-term financial obligations effectively. On the other hand, the debt equity ratio indicates the proportion of debt financing relative to equity financing in KSFC's capital structure. A higher ratio implies a higher degree of financial leverage and potential risk. Comparing the debt equity ratio for March 31, 2023 (2.56) with that of March 31, 2014 (3.378), there appears to have been a decrease over time. This decrease suggests that KSFC may have reduced its reliance on debt financing relative to equity financing.

4. Objectives and Methodology

The main objective of this study is to evaluate the performance of the Karnataka State Financial Corporation in fostering the growth and advancement of MSMEs. Naturally, assessing KSFC's performance from various perspectives within a single research paper presents challenges. Therefore, this study focuses on evaluating the corporation's performance based on factors such as the number of assisted units, the total amount of assistance provided, purpose-specific loan assistance, and the benefits of interest subsidies obtained through different schemes of the Government of Karnataka. Further, it examines the amount of gross loans sanctioned, loan disbursements, and loan recoveries as indicators of performance.

For the purpose of examining and appraisal of the KSFC and its impact on development and growth of MSMEs in the state, relevant data are collected from the KSFC. The period of study is 10 years from 2013-14 to 2022-23, encompassing all four of its circles and 30 branch offices.

For data analysis, a few descriptive statistical measures are employed, including mean, standard deviation and coefficient of variation (CV), alongside the compound annual growth rate (CAGR). Additionally, regression analysis and correlation are utilized to test the hypotheses.

5. Analysis and Discussion

As already stated, the present study examines the performance and its impact on the improvement and growth of MSMEs from the point of view (i) Number of MSMEs units assisted (ii) Amount of financial assistance to MSMEs (iii) Purpose-wise Financial Assistance to MSMEs (iv) Sanctioned No. of Units, Gross Loans, Disbursement of Loans and Total Recovery (v) Assistance to Entrepreneurs under Interest Subsidy Schemes of GoK. Based on this analysis, it examines the impact of MSMES on their performance.

5.1. Number of MSMEs Assisted

The core objective of assisting MSMEs by KSFC is to stimulate economic development by providing financial support and resources to a significant number of MSMEs. This initiative wishes to foster entrepreneurship, generate employment opportunities, and enhance the overall competitiveness of the sector. Details of the number of MSMEs assisted by the corporation during the study period are presented below (Table -1).

Table 1: Number of MSMEs assisted by KSFC during 2013-14 to 2022-23

Year (March End)	Number of Units			Total
	Micro & Small Industries	Micro Enterprises	Units other Small Scale Units	
2013-14	1,157	318	269	1,426
2014-15	915	231	177	1,092
2015-16	922	262	189	1,111
2016-17	944	183	115	1,059
2017-18	957	176	80	1,037
2018-19	979	128	77	1,056
2019-20	663	80	47	710
2020-21	417	102	28	445
2021-22	443	128	18	461
2022-23	676	197	34	710
CAGR and Descriptive Statistics				
CAGR (%)	-5.23	-4.67	-18.68	-6.74
Total	8,073.00	1,805.00	1,034.00	9,107.00
Minimum	417.00	80.00	18.00	445.00
Maximum	1,157.00	318.00	269.00	1,426.00
Mean	807.30	180.50	103.40	910.70
Standard Deviation	245.11	74.66	83.35	315.74
CV (%)	30.36	41.36	80.61	34.67

Source: Author based on data compiled and retrieved from <https://ksfc.karnataka.gov.in>

The table above illustrates KSFC's support to the industrial units with their financial needs. While the institution's performance varied from year to year, it's noteworthy that a total of 9,107 MSMEs were assisted during the period spanning from 2013-14 to 2022-23. The number of micro & small industries assisted ranged from a minimum of 417 in 2020-21 to a maximum of 1,157 in 2013-14. Similarly, the number of micro enterprises assisted ranged from a minimum of 80 in 2019-20 to a maximum of 318 in 2013-14. Even the number of other Small Scale Units assisted ranged from a minimum of 18 in 2021-22 to a maximum of 269 in 2013-14. The average number of MSMEs assisted per year is 807 for micro & small industries, 180 for micro enterprises, and 103 for other small scale units. However, the data shows a negative trend in the number of MSMEs assisted, as indicated by the negative CAGR values for all categories and the coefficient of variation (CV) indicates relatively high variability in the number of micro

& small industries and other small scale units assisted compared to micro enterprises. Overall, the analysis suggests fluctuations and a decreasing trend in the number of MSMEs assisted over the years, with varying degrees of variability across different categories.

5.2. Amount of Financial Assistance for Development of MSMEs

As already stated, the initiatives are centered on offering a spectrum of financial products and services to aid the growth and sustainability of MSMEs. These encompass term loans, working capital finance, equipment financing, and project financing, all finely tuned to cater to the diverse requirements of MSMEs at different stages of their business journey. What sets KSFC apart is its commitment to flexibility, ensuring that MSMEs have access to funds with competitive interest rates, along with personalized repayment structures that align with their cash flow needs. Moreover,

KSFC goes beyond just financial assistance, offering advisory and consultancy services aimed at bolstering the financial acumen of MSMEs and enhancing their overall competitiveness in the market. In this background, the amount of financial assistance provided by KSFC is Table -2.

Table 2: Amount of Financial Assistance for Development of MSMEs by KSFC

Year (March End)	Amount (Rs. Lakhs)			Total
	Micro & Small Industries	Micro Enterprises	Units other Small Scale Units	
2013-14	57,541.38	8,011.08	33,384.67	90,926.05
2014-15	48,215.20	5,607.45	19,299.40	67,514.60
2015-16	51,494.11	6,470.13	21,699.48	73,193.59
2016-17	54,715.75	5,250.55	18,626.80	73,342.55
2017-18	75,326.10	5,506.25	8,886.60	84,212.70
2018-19	99,941.18	3,852.45	9,931.52	1,09,872.70
2019-20	60,167.54	2,113.35	6,613.00	66,780.54
2020-21	37,577.17	5,235.75	2,588.40	40,165.57
2021-22	47,467.87	8,459.00	1,857.28	49,325.15
2022-23	86,128.47	14,243.31	3,981.23	90,109.70
CAGR and Descriptive Statistics				
CAGR (%)	4.11	5.92	-19.16	-0.09
Total	6,18,574.77	64,749.32	1,26,868.38	7,45,443.15
Minimum	37,577.17	2,113.35	1,857.28	40,165.57
Maximum	99,941.18	14,243.31	33,384.67	1,09,872.70
Mean	61,857.48	6,474.93	12,686.84	74,544.31
Standard Deviation	19,389.14	3,287.52	10,233.97	20,502.25
CV (%)	31.34	50.77	80.67	27.50

Source: Same as Table1.

The total amount of financial assistance provided for the development of MSMEs during the period from 2013-14 to 2022-23 is Rs. 7,45,443.15 lakhs. This amount varies across different categories, with micro & small industries receiving the highest total assistance. Thus, the mean amount of financial assistance per year is Rs. 61,857.48 lakhs for micro & small industries, Rs. 6,474.93 lakhs for micro enterprises, and Rs. 12,686.84 lakhs for other small scale units. However, the data shows positive trends in the amount of financial assistance for micro & small industries and micro enterprises, as indicated by the positive CAGR values. The coefficient of variation (CV) suggests relatively high variability in the amount of financial assistance provided to micro enterprises compared to other categories.

5.3. Purpose-wise Financial Assistance

KSFC aims to foster their growth and sustainability. These businesses, vital to economic development, often face capital constraints. Financial aid is tailored to specific needs, such as startup funding, working capital, technology adoption, or expansion. Government initiatives, bank loans, venture capital, and grants are common sources of support. By facilitating access to funds, MSMEs can innovate, create employment, and contribute significantly to GDP growth, fostering a robust entrepreneurial ecosystem. The purpose-wise financial assistance are presented below Table -3.

Table 3: Purpose-wise Financial Assistance by KSFC, 2013-14 to 2022-23

Year (March End)	New Projects (Loan Sanctioned)		Others (Expansion, Modernisation, Escalation etc.) - Loan Sanctioned	
	No. of Units	Amount (Rs. Lakhs)	No. of Units	Amount (Rs. Lakhs)
2013-14	541	52193.22	885	38732.83
2014-15	420	33619.40	672	33895.20
2015-16	505	43521.73	606	29671.86
2016-17	578	49900.05	481	23442.50
2017-18	624	60938.40	413	23274.30
2018-19	675	85920.98	381	23951.72
2019-20	460	51139.69	250	15640.85
2020-21	270	29166.55	175	10999.02
2021-22	287	34598.63	174	14726.52
2022-23	459	67539.22	251	22570.48
CAGR and Descriptive Statistics				
CAGR (%)	-1.63	2.61	-11.84	-5.26
Total	4819.00	508537.87	4288.00	236905.28
Minimum	270.00	29166.55	174.00	10999.02
Maximum	675.00	85920.98	885.00	38732.83
Mean	481.90	50853.79	428.80	23690.53
Standard Deviation	132.69	17313.92	234.96	8653.61
CV (%)	27.53	34.05	54.79	36.53

Source: Same as Table1.

We observe the financial assistance provided for new projects and other purposes (like expansion, modernization, etc.) for the period from 2013-14 to 2022-23. Both categories, new projects and other purposes, show fluctuations in the number of units and the amount of loan sanctioned over the years. However, there are some noticeable trends, new projects and other purposes have experienced a slight decline over the years, as indicated by the negative Compound Annual Growth Rate (CAGR) of (-1.63%), (-11.84) and (-5.26) respectively. On the other hand, the amount of loan sanctioned for new enterprises have shown a positive growth trend, with a CAGR of (2.61%). Even the new projects consistently receive higher financial assistance compared to other purposes. Despite the decline in the number of units for new projects, the amount sanctioned is still relatively higher, indicating larger individual investments.

Total amount of financial assistance provided for new projects over the period is Rs. 508,537.87 lakhs, whereas for other purposes, it's Rs. 236,905.28 lakhs. The mean amount sanctioned for new projects is significantly higher than for other purposes, indicating the emphasis on investing in new ventures. Standard deviation and coefficient of variation (CV) are relatively high for both categories, suggesting considerable variability in the amount of financial assistance provided over the years. Besides, there are fluctuations in the number of units and the amount sanctioned each year for both categories. Some years show spikes in the amount sanctioned, which may correspond to specific economic conditions, policy changes, or industry trends.

It is clear from the above analysis that, while continuing to support new projects, it may be beneficial to diversify financial assistance

to include more support for other purposes, especially considering the positive growth trend in this category. Further analysis into the factors contributing to variability in loan amounts could help in understanding the specific needs of industries and businesses. Considering the fluctuating trends, long-term planning and flexibility in financial assistance schemes could help in adapting to changing economic conditions and industry demands. Regular review of policies regarding financial assistance could ensure alignment with current economic goals and industry requirements. It is essential to take into account external factors like shifts in government policies, economic circumstances,

and technological progress, as these can greatly influence the demand for financial aid and the outcomes of projects.

5.4. Gross Loans, Disbursement of Loans and Total Recovery

KSFC plays a vital role in facilitating financial support to MSMEs. Gross loans represent the total amount of funds extended to MSMEs for various purposes. Disbursement of loans indicates the actual distribution of funds to MSMEs for their operations and expansions. Total recovery signifies the amount retrieved by KSFC from MSME borrowers. Table – 4 shows the annual trends in these indicators.

Table 4: Gross Loans, Disbursement of Loans and Total Recovery by KSFC

Year	No. of Units	Amount (Rs. Crores)		
		Gross Loans	Disbursement of Loans	Total Recovery
2013-14	1,426	909.26	707.47	836.52
2014-15	1,092	675.15	553.62	814.00
2015-16	1,111	731.94	566.36	841.10
2016-17	1,059	733.43	614.38	884.73
2017-18	1,037	842.13	561.21	787.91
2018-19	1,056	1,098.73	665.90	736.35
2019-20	710	667.81	727.90	720.85
2020-21	445	401.66	432.96	638.68
2021-22	461	493.25	386.46	741.89
2022-23	710	901.10	445.81	763.71
CAGR and Descriptive Statistics				
CAGR (%)	-6.74	-0.09	-4.51	-0.91
Total	9,107.00	7,454.46	5,662.07	7,765.74
Minimum	445.00	401.66	386.46	638.68
Maximum	1,426.00	1,098.73	727.90	884.73
Mean	910.70	745.45	566.21	776.57
Standard Deviation	315.74	205.02	116.95	71.56
CV (%)	34.67	27.50	20.65	9.21

Source: Same as Table1.

A close observation of the table above displays that continuous decrease in the Number of units sanctioned followed by gross loans, disbursement of loans, and total recovery vary over the years, indicating fluctuations in lending

activities and repayment performance. However, gross loans and total recovery show a declining trend, while disbursement of loans fluctuates with no clear trend. As in the case of mean gross loans, disbursement, and total recovery are Rs. 910.70

crores, Rs. 745.45 crores, and Rs. 776.57 crores respectively. Standard deviation and coefficient of variation (CV) are relatively high for gross loans, indicating variability in loan amounts sanctioned.

Further, 2018-19 stands out with the highest gross loans, suggesting increased lending activities during that period. However, total recovery for the same year is relatively low, indicating potential challenges in loan recovery despite high disbursement.

In the lines of the above analysis that, implementing robust debt recovery mechanisms and strategies to improve the total recovery rate, ensuring timely repayments from MSME borrowers. Conducting thorough risk assessments before sanctioning loans to minimize the risk of default and enhance overall loan recovery rates. Even the diversifying the loan portfolio to reduce dependence on specific sectors or industries, thereby mitigating risks associated with economic fluctuations. Regular monitoring of loan

disbursement and repayment activities to identify early signs of delinquency and take proactive measures to address them.

5.5. Assistance to Entrepreneurs under Interest Subsidy Schemes of GoK

KSFC aims to foster entrepreneurial growth by providing financial support in the form of interest subsidies. These schemes alleviate the burden of high-interest rates on loans for budding entrepreneurs, facilitating easier access to capital. By reducing financial barriers, the GoK endeavors to stimulate entrepreneurship, fuel innovation, and bolster economic development across various sectors. Through these initiatives, the government seeks to empower aspiring entrepreneurs, encourage job creation, and ultimately contribute to the overall prosperity and growth of Karnataka's economy. Details about the amount of interest subsidies are availed under different schemes of the state government are presented Table - 5.

Table 5: Assistance to Entrepreneurs by KSFC under Interest Subsidy Schemes of GoK

Year (March End)	Scheduled Caste Entrepreneurs		Scheduled Tribe Entrepreneurs		Women Entrepreneurs	
	No. of Units	Amount (Rs. Lakhs)	No. of Units	Amount (Rs. Lakhs)	No. of Units	Amount (Rs. Lakhs)
2013-14	204	7,815.30	79	3,107.85	-	-
2014-15	200	7,543.50	75	2,653.00	-	-
2015-16	284	15,022.49	96	4,891.85	63	2,345.95
2016-17	222	17,961.54	102	6,632.41	358	14,602.20
2017-18	260	21,393.30	83	5,527.70	350	20,084.00
2018-19	245	20,718.08	85	5,656.20	271	26,460.31
2019-20	169	11,253.00	52	3,539.00	165	14,515.30
2020-21	150	12,599.00	42	3,503.00	8	1,100.00
2021-22	135	12,107.00	42	4,353.58	37	4,276.11
2022-23	196	21,457.00	72	7,208.02	105	13,113.00
Total	2,065	14,7870.2	728	47,072.61	1,357	96,496.87

Source: Same as Table1.

Note: Details about Assistance to Women Entrepreneurs under Interest Subsidy Schemes of GoK during 2013-14 and 2014-15 are not available.

It is evident from the table above that, the total number of units and the amount disbursed have varied over the years. There's a general trend of fluctuation in the number of units assisted and the amount disbursed, indicating possible shifts in policy focus or economic conditions. Even in the case of SC entrepreneurs, the number of units assisted and the amount disbursed have fluctuated but generally show a decreasing trend towards recent years. However, the overall amount disbursed to SC entrepreneurs is substantial, indicating a significant focus on uplifting this marginalized group. Similar to SC entrepreneurs, the number of units and the amount disbursed to ST entrepreneurs have varied over the years. There's a notable increase in the amount disbursed from 2016-17 onwards, suggesting heightened support to ST entrepreneurs in recent years. On the other hand, the support to women entrepreneurs, in terms of both the number of units and the amount disbursed, has shown fluctuations over the years. There is also a visible increase in support from 2015-16 to 2018-19, followed by a decline in the subsequent years.

What is apparent from this analysis that, while there are fluctuations in yearly data, the overall trend indicates a significant amount disbursed to SC entrepreneurs, followed by ST entrepreneurs and then women entrepreneurs. There seems to be a decrease in support to women entrepreneurs in recent years, which could be a concern area for policy review and intervention.

5.6. Testing of Hypotheses

Although the above descriptive analysis throws light on the trend, relationship and impact, it is an appropriate to apply a few statistical tests for the purpose of testing the hypotheses as presented below.

(a) H_{01} : **There is no significant impact of financial assistance on the growth of MSMEs in the state during the study period.**

Based on the detailed calculations made (using the data presented in tables – 1 to 2), the summary result of Regression Analysis (ANOVA) is obtainable below table (Table – 6) followed by the inference of result.

Table 6: ANOVA (Summary Result of Regression Analysis)

Model	Sum of Squares	df	Mean Square	F	t	R-Square	Standard error of the estimate	Sig.
Regression	399131.556	1	399131.556	6.410	0.464	0.445	249.52869	.035 ^b
Residual	498116.544	8	62264.568					
Total	897248.100	9						

Source: Author's estimation.

From the above table, it is observed that the $F(1, 8) = 6.410$, Mean Square (MSE) = 62264.568, ($p = 0.035 < 0.05$), therefore, overall regression is a good fit. The first null hypothesis, H_{01} : There is no significant impact of financial assistance on the growth of MSMEs in the state during the study period is tested and rejected. Hence, the alternative hypothesis (H_1) is accepted, implies that there is a significant impact of financial assistance on the growth of MSMEs in the state during the study period.

(b) H_{02} : There is no significant relationship between gross loans sanctioned by the KSFC and its total recovery during the study period.

For the purpose of testing the above null hypothesis, correlation value is determined and tested for the type of relationship that exists between gross loans sanctioned on the one hand, and the amount of total recovery on the other. In this case, $n = 10$ (i.e., 10 years), and the degree of freedom (DF) is 8 ($10 - 2$). Hence, the critical

value associated with the degree of freedom = 8 is ± 0.632 (i.e., -0.632 to 0.632). If the obtained value of 'r' falls between (-) 0.632 and (+) 0.632, the relationship between the two variables is insignificant and therefore, the null hypothesis is accepted. On the other hand, if the obtained

value of 'r' exceeds (-) 0.632 or if it exceeds (+) 0.632, the relationship between the two variables is significant and therefore, null hypothesis is rejected. With this introduction, summary result of correlation analysis (based on the data in table – 4).

Table 7: Correlation Value – Relationship between Gross Loans Sanctioned and Total Recovery

Relationship between		Total Recovery	Gross Loans Sanctioned
Total Recovery	Pearson Correlation	1	
	Sig. (2-tailed)		
	N	10	
Gross Loans Sanctioned	Pearson Correlation	0.382	1
	Sig. (2-tailed)	0.277	
	N	10	10

Source: Author's estimation.

As far as the relationship between gross loans sanctioned by the KSFC and total recovery is concerned, coefficient of correlation($r = 0.382$), the obtained value of 'r' falls within the acceptance region of (-) 0.632 and (+) 0.632. Therefore, the second null hypothesis, H02: There exists no significant relationship between gross loans sanctioned by the KSFC and its total recovery during the study period is tested and accepted. This implies that within the operations of the KSFC, the amount of gross loans sanctioned does not have a significant impact on the total recovery.

5.7. Impact of the pandemic on the operations of KSFC in assisting MSMEs

The concerted efforts by KSFC both before and during the pandemic have significantly contributed to the resilience and recovery of the MSME sector in Karnataka. By maintaining a robust support system and adapting to the evolving needs of businesses during the crisis, KSFC has helped numerous enterprises survive and sustain their operations. Table - 8 contains detailed data on the assistance provided to MSMEs by the Karnataka State Financial Corporation (KSFC) before and including the pandemic period.

Table 8: MSMEs Assisted Before Pandemic and Including Pandemic Period by KSFC

Year	Before Pandemic Period			Including Pandemic Period				
	No. of Units	Amount (Rs. Crores)		Year	No. of Units	Amount (Rs. Crores)		
		Gross Loans	Disbursement of Loans	Total Recovery		Gross Loans	Disbursement of Loans	Total Recovery
2013-14	1,426	909.26	707.47	836.52	2013-14	909.26	707.47	836.52
2014-15	1,092	675.15	553.62	814.00	2014-15	675.15	553.62	814.00
2015-16	1,111	731.94	566.36	841.10	2015-16	731.94	566.36	841.10
2016-17	1,059	733.43	614.38	884.73	2016-17	733.43	614.38	884.73
2017-18	1,037	842.13	561.21	787.91	2017-18	842.13	561.21	787.91
2018-19	1,056	1,098.73	665.90	736.35	2018-19	1,098.73	665.90	736.35
2019-20	710	667.81	727.90	720.85	2019-20	667.81	727.90	720.85
					2020-21	401.66	432.96	638.68
					2021-22	493.25	386.46	741.89
					2022-23	901.10	445.81	763.71
CAGR and Descriptive Statistics								
CAGR (%)	-9.48	-4.31	0.41	-2.10		-0.09	-4.51	-0.91
Total	7,491	5,658.45	4,396.84	5,621.46	9,107.00	7,454.46	5,662.07	7,765.74
Minimum	710	667.81	553.62	720.85	445.00	401.66	386.46	638.68
Maximum	1,426	1,098.73	727.9	884.73	1,426.00	1,098.73	727.90	884.73
Mean	1070.14	808.35	628.12	803.06	910.70	745.45	566.21	776.57
Standard Deviation	208.13	155.24	72.70	58.87	315.74	205.02	116.95	71.56
CV (%)	19.45	19.20	11.57	7.33	34.67	27.50	20.65	9.21

Source: Same as Table I.

The number of units assisted ranged from a minimum of 710 in 2019-20 to a maximum of 1,426 in 2013-14, with a mean of 1,070.14 units and a standard deviation of 208.13. The coefficient of variation (CV) is 19.45%, indicating moderate variability. The number of units assisted dropped initially to 445 in 2020-21 but showed recovery to 710 in 2022-23. The mean is lower at 910.70 units, with a higher standard deviation of 315.74 and CV of 34.67%, indicating higher variability during the pandemic period.

Gross loans fluctuated between Rs. 667.81 crores and Rs. 1,098.73 crores, with an average of Rs. 808.35 crores and a standard deviation of Rs. 155.24 crores (CV:19.20%). Gross loans showed a slight overall increase, with a mean of Rs. 745.45 crores and a standard deviation of Rs. 205.02 crores (CV:27.50%), reflecting greater variability due to the pandemic. The disbursement of loans ranged from Rs. 553.62 crores to Rs. 727.90 crores, with an average of Rs. 628.12 crores and a standard deviation of Rs. 72.70 crores (CV:11.57%). The average disbursement decreased to Rs. 566.21 crores with a higher standard deviation of Rs. 116.95 crores (CV: 20.65%), indicating more fluctuation during the pandemic. Total recovery ranged from Rs. 720.85 crores to Rs. 884.73 crores, with a mean of Rs. 803.06 crores and a standard deviation of Rs. 58.87 crores (CV: 7.33%). Total recovery showed a slight increase in average to Rs. 776.57 crores with a standard deviation of Rs. 71.56 crores (CV: 9.21%), again indicating greater variability.

The compound annual growth rate (CAGR) is -9.48% before the pandemic, which improves to -6.74% when including the pandemic period. This negative growth highlights the decline in the number of units assisted, exacerbated by the pandemic. The CAGR for gross loans is -4.31% before the pandemic, improving to -0.09% including the pandemic, showing that the impact on gross loans was mitigated over time. The CAGR is 0.41% before the pandemic, turning negative to -4.51% during the pandemic, reflecting

the challenges in loan disbursements during the pandemic. The CAGR of total recovery is -2.10% before the pandemic, improving slightly to -0.91% during the pandemic period.

The data reflects a significant impact of the pandemic on the operations of KSFC in assisting MSMEs. There was a noticeable decline in the number of units assisted during the pandemic, with the lowest number recorded in 2020-21. The standard deviations and coefficients of variation for all parameters increased during the pandemic period, indicating greater uncertainty and fluctuations in financial operations. The negative CAGR in loan disbursements during the pandemic highlights the difficulties faced in maintaining consistent financial support to MSMEs. Despite the challenges, total recovery figures remained relatively stable, showing KSFC's effectiveness in managing loan recoveries even during the crisis.

The analysis underscores the resilience of KSFC in maintaining support for MSMEs during challenging times, though with noticeable strain on the number of units assisted and loan disbursement. Thus, strategies to enhance financial support and stabilize assistance to MSMEs will be crucial in mitigating the long-term impacts of the pandemic and fostering economic recovery.

6. Conclusion and Implications

Main conclusions from within the analysis of the paper are as follows.

- While KSFC has consistently assisted MSMEs over the years, there's a declining trend in the number of units assisted. The variability in assistance across different categories indicates the need for a more consistent approach.
- Financial assistance has been provided across various categories, with positive trends observed in assistance for micro & small industries and micro enterprises. However, there's a need to address the high variability in assistance to ensure more equitable support.

- New projects receive significant support, but there's room for diversification in assistance to cover other purposes. Understanding factors contributing to variability can aid in tailoring support more effectively.
- Fluctuations in lending activities and recovery rates call for robust debt recovery mechanisms and risk assessment strategies to enhance overall performance.
- While substantial support is provided, there's a need to review policies to ensure consistent and equitable assistance, particularly for women entrepreneurs.

References

- Ministry of Micro, Small and Medium Enterprises, Annual Report, 2022-23, Government of India, New Delhi.
- Guntur Anjana Raju & Mythili Kurpad. (Summer 2013). SME securitization: A new ray of hope for SMEs in India. *Journal of Structured Finance*. 19(2): pp. 89-119.
- Siddiqui, M. A. (2017). MSMES Finance availability: Is there any change in the scenario. *ZENITH International Journal of Multidisciplinary Research*, 7(10), 229-236.
- Kar, B., & Mohanty, S. (2015). Revisiting the role of state financial corporations for entrepreneurship finance in India: 'Phoenix' or a 'Swan Song'.
- <https://ksfc.karnataka.gov.in/info-1/Annual+Report+and+Operational+Statistics/en>
- D'silva, A., & Rejin, E. V. (2018). Credit appraisal process of Karnataka State financial corporation for women entrepreneurs. *International Journal of Research in Social Sciences*, 8(8), 386-400.
- Nagaraj, H., Reddy, B. S., & Satihal, D. G. (2017). Impact of Karnataka state finance corporation on micro, small and medium enterprise development in Karnataka, India. *Indian Journal of Economics and Development*, 1-7.
- Partha, T., & Nagaraja, N. (2014). Institutional Framework to Promote Micro, Small and Medium Enterprises in India. *International Journal of Engineering and Management Research (IJEMR)*, 4(6), 196-203.
- Iota Kaousar Nassr & Gert Wehinger. (2014). UNLOCKING SME finance through market-based debt: Securitisation, private placements and bonds. *OECD Journal: Financial Market Trends*. 2014(2): pp. 89-190.
- Parameshwara . (2015) . Recovery management of commercial bank loans to small scale industries – A study in Dakshina Kannada and Udupi districts. Thesis submitted to Mangalore University (unpublished).
- Sharma, S., & Dhaliwal, N. K. (2011). Financing of micro, small and medium enterprises (MSMEs) by The Small Industries Development Bank of India (Sidbi). *Asia Pacific Journal of Research in Business Management*, 2(8), 134-144.

Decomposition of Socioeconomic Inequality in Child Stunting in India

Santosh Tamang¹ and Uttam Kumar Sikder²

Abstract

Child stunting, a common form of chronic malnutrition, is prevalent among poor under five children in India. This study examines the disparities in child stunting through data obtained from the National Family Health Surveys spanning from 2005-06 to 2019-21. We use concentration index (CI) and regression-based decomposition analysis to assess the extent and determinants of socioeconomic inequality in child stunting. Our findings reveal persistent socioeconomic disparities in child stunting, with higher burdens observed among disadvantaged households. Factors such as sex of the child, birth order, birth interval, birth weight, timing and duration of breastfeeding, maternal BMI, maternal education, caste, residence type, and access to basic amenities significantly contribute to these inequalities. Efforts to enhance access to education, healthcare, and basic amenities, particularly among marginalized communities, are crucial for achieving the equitable child health outcomes and sustainable development goals in India.

JEL Classification Codes: H51, H52, I140, O15

1. Introduction

Nutritional status determines health and wellbeing of a child which further affects the growth of a child. The nutritional status of children of a country has a direct impact on its economic growth and development (Priyanka et al., 2016). Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and /or nutrients (WHO, 2023). WHO estimates revealed that 41 million children under the age of 5 years are overweight or obese, while about 159 million are stunted and 50 million are wasted. Nearly half of all deaths in children under 5 are attributable to under nutrition as it puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and delays recovery (UNICEF, 2023). WHO uses three indicators for measuring nutrition viz. stunting, wasting, and underweight. Stunting is a situation when children suffer from growth retardation as a result of poor diets or recurrent

infections lead to be greater illness and death. It is also called chronic malnutrition as it results in long-term nutritional deprivation. Wasting in children is a symptom of acute under-nutrition, usually a consequence of insufficient food intake or high incidence of infectious diseases, especially diarrhea. Underweight includes both acute and chronic malnutrition. For our study, we have taken stunting as an indicator for nutritional status of children.

Stunting is a result of chronic or recurrent under nutrition, and is defined as low height-for-age. It is associated with poverty, poor maternal health and nutrition, frequent illness and /or inappropriate feeding and care in early life, which may prevent children from reaching their physical and cognitive potential (WHO). During last few decades, stunting has been one of the major public health concerns in low and middle

¹Ph.D Scholar, Department of Economics and Politics, Visva Bharati, Santiniketan, Kolkata-731235. E-mail: santoshlopchan83@gmail.com

²Assistant Professor, Department of Economics and Politics, Visva Bharati, Santiniketan, Kolkata-731235. E-mail:uksikder.eco@gmail.com

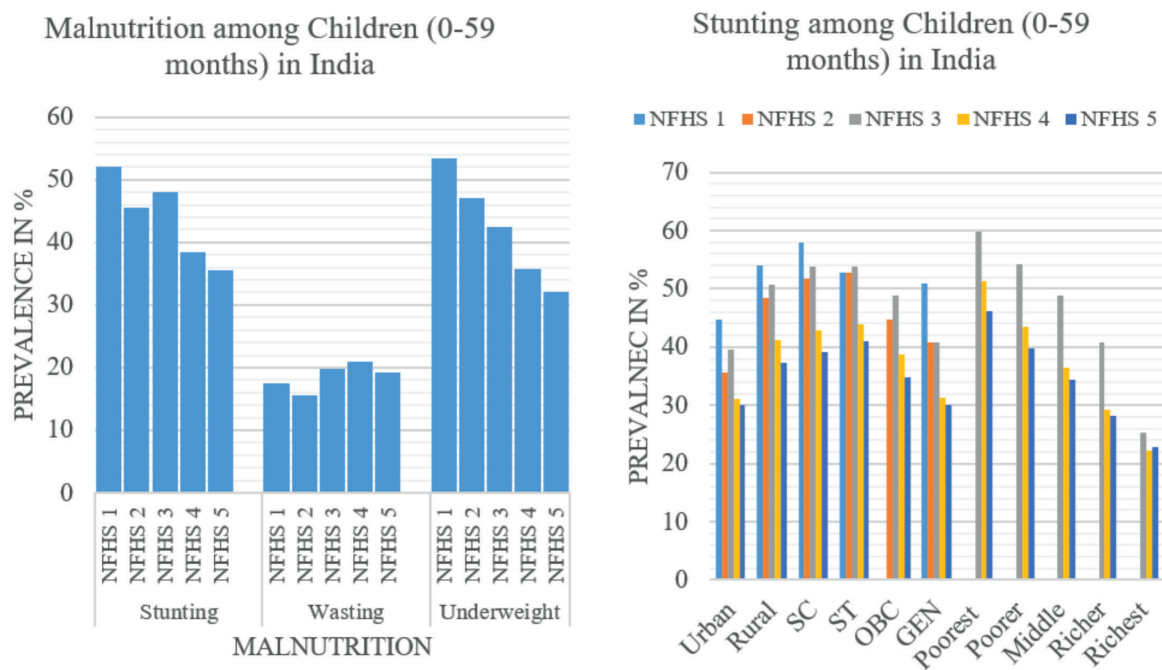
income countries. While UNICEF-WHO-World Bank Group Joint Malnutrition Estimates shows that stunting prevalence has been declining, 148.1 million under five children (more than one in five) were stunted globally in 2022, accounting 22.3 percent of all children under five years (UNICEF, 2023). As per WHO report (WHO, 2023), the situation is worse in Asia which accounts for 52 percent of under-five children affected by stunting.

In India, stunting among children of age below 5 years is significant. Despite recent economic progress, the fruit of economic development has failed to secure a better nutritional status of children in the country (Shiva Kumar, 2007; Svedberg, 2006). Though stunting among under-five children in India has declined from 52% in 1994-95 to 36% in 2019-21, it continues to be high and far away to achieve SDG Target 2.2 “to end all forms of malnutrition by 2025”.

Access to food and improved nutrition is a basic human right and one of the central goals

of development process to reduce poverty and inequality. Under-nutrition is a global public health and development concern with important health and socioeconomic consequences. Chronic malnutrition, measured by stunting, is one of the best indicators of child nutrition and provides an indirect assessment of quality of life. Though India has made commendable progress in health sector since independence by reducing child and maternal mortality and raising life expectancy, it is yet to achieve the desired targets and equity in health outcomes. Inequity in malnutrition is evident from the reports of NFHS-5. Incidence of stunting is continuously higher in rural children than urban children over the period of 1992-93 to 2019-21. At the same time, the percentage of stunted children are significantly higher among SC and ST children than children belonging to general category. The incidence of stunting rises as we move from lower to higher wealth status. Trends in India’s child malnutrition and stunting are presented in Figure 1.

Figure 1: Trends in malnutrition among under-five children in India, NFHS 1 to 5



Source: Authors’ compilation from NFHS -various rounds.

2. Data and methodology

2.1. Data

The present study uses the secondary data from three rounds of National Family Health Survey (NFHS) conducted during 2005-06 (NFHS 3), 2015-16 (NFHS 4) and 2019-21 (NFHS 5) in all states and Union Territories of India. The NFHS is a national representative sample survey of households and data are of large scale and cross-sectional. The surveys are conducted by International Institute of Population Sciences (IIPS) in Mumbai for the Ministry of Health and Family Welfare, Government of India.

2.2. Variables

The outcome variable is ‘child stunting³’ which represents the chronic nutritional status of children. Child stunting is a binary variable which takes the value one if child is ‘stunted’ and zero if not stunted.

We use the wealth index of household provided in NFHS data as a measure of socioeconomic status of the household when income or expenditure data are not available (O’Donnell, Doorslaer, Wagstaff & Lindelow, 2007). The wealth index is constructed through the Principal Components method that assigns a score to each household based on the selected household assets by the NFHS. The households in our study are ranked based on this index.

The explanatory variables included are:

- i. Child Factors
 - a. Sex of child categorized as boy or girl.
 - b. Birth order
 - c. Birth Interval: gap between two successive children.
 - d. Birth weight: weight of child at birth categorized as normal weight (if child weighs 2500 gm or more) and underweight if child weighs less than 2500 gm.
 - e. Timing of first breastfeeding: categorized in two groups (within Day 1 and beyond Day 1 of birth)
 - f. Duration of breastfeeding (in months).
- ii. Maternal Factors
 - a. Mother’s Body Mass Index (BMI) categorized as Normal (if $18.5 \leq \text{BMI} \leq 25$ kg/m²) and Not Normal.
 - b. Mother’s anemia status: anemia level is defined by hb level < 12 g/dl; and categorized as ‘not anemic’ and ‘anemic’.
 - c. Mother’s education (in completed years).
- iii. Socioeconomic Factors
 - a. Wealth status categorized as poor, middle and rich.
 - b. Caste (social category) categorized in GEN, SC, ST and OBC.
 - c. Type of residence: urban and rural
 - d. Basic Amenities Index (BAI) : composed of three indicators viz. type of drinking water facility, toilet facility and cooking fuel. BAI takes values 0 to 9 depending upon the quality of basic amenities.

³ NFHS measures the stunting via Height-for-Age Z-score (HAZ), which is a measure of linear growth retardation and cumulative growth deficits. Children whose HAZ is below minus two standard deviations (-2SD) from the median from the reference population are considered stunted or chronically undernourished (NFHS 5).

2.3. Statistical methods

The concentration index (CI) is used as a measure of socioeconomic inequality in child stunting. It is computed as twice the covariance of health outcome and a person's relative rank based on economic status, divided by the mean of health outcome. The formula for calculation of concentration index (CI) is given as follows.

$$CI = \frac{2}{\mu} cov_w (h_i, R_i) \quad (1)$$

where h_i represents health status of i th individual and R_i represents fractional rank of an i th individual, μ is weighted mean of health outcome, and cov_w is weighted covariance.

The value of CI ranges between -1 to +1. CI takes the value 0 if there is no socio-economic inequality. The negative value of CI implies that the relevant health variable is concentrated among poor or disadvantaged people whereas the positive CI value indicates that health variable is concentrated among rich people. The value of CI for stunting, being a binary outcome variable, will not lie within the range of -1 and +1 because its value depends on the mean of stunting. Thus, normalization of CI is required to measure inequality (Wagstaff, 2005). We use Wagstaff normalization of CI as follows.

$$CI = \frac{2}{(1-\mu)\mu} cov_w (h_i, R_i) \quad (2)$$

Although concentration index is relevant to measure the extent of socioeconomic inequalities in stunting, it is less useful to explain the contribution of factors to observed inequality. To overcome this limitation, we use the regression-based methodology to decompose the socioeconomic inequality in child stunting, following Wagstaff (Wagstaff, Doorslaer & Watanabe, 2003). The estimation model is given as:

$$y_i = \alpha + \sum \beta_k x_{ki} + \varepsilon_i \quad (3)$$

where x_{ki} is a set of k regressor variables for i th individual, β_k denotes k th coefficient, and ε_i is an error term. The CI can be decomposed as follows:

$$C = \sum \left(\frac{\beta_k x_{ki}}{\mu} \right) C_k + \frac{GC\varepsilon}{\mu} \quad (4)$$

where μ is mean of y , \bar{x}_k is the mean of x_k , C_k is normalized concentration index of x_k , $\beta_k \bar{x}_k / \mu$ is elasticity of the child stunting with explanatory variables, and $GC\varepsilon$ is the generalized CI for residual.

Equation (4) shows that C has two components. The first is 'explained' component which is weighted sum of CI of regressors and weights are elasticities. These elasticities measure the amount of change in dependent variable due to one unit change in explanatory variables. The second is 'unexplained' component, which reflects the inequality in health outcome that cannot be explained by the set of dependent variables considered here.

In our analysis, child stunting is measured as a binary variable taking the value of one or zero, depending on whether child is stunted or not. Two standard regression model can be used for binary variables: Linear Probability Model (LPM) and the nonlinear Logit Model. The LPM can yield estimates of probability of child stunting that are either less than zero or more than 1 and has heteroscedastic errors. The logit model is intrinsically non-linear in probability of stunting, but linear in propensity to child stunting (latent variable) which is natural logarithm of odds of stunting. Thus, Logit method is appropriate to use for linear decomposition method (Hosseinpoor et al., 2006; Speybroeck et al., 2010).

$$\ln(\text{Stunting}) = \alpha + \sum \beta_k x_{ki} + \varepsilon_i \quad (5)$$

Inequality in stunting explained by observed values of explanatory variables. Accordingly, the

first component of the decomposition equation is used to measure $C\hat{y}$:

$$C = \sum \left(\frac{\beta_k x_{ki}}{\mu} \right) C_k \quad (6)$$

3. Results

3.1. Descriptive statistics

Table 1 shows the descriptive statistics of variables included in the estimation from three rounds of NFHS (2005-06, 2015-16 & 2019-21). Prevalence of stunting is reduced from 44 percent of under-five children in 2005-06 to 39 percent in 2015-16, and further reduced to 35 percent in 2019-21. This implies an improvement in nutritional level among children over 15 years with nine percent point reduction. For explanatory variables, average birth interval between two births has increased from 37 months in 2005-

06 to 40 months in 2019-21. The percentage of underweight children born has declined from 20% to 17% during the same period. The percentage of breastfed children after Day 1 of birth has also reduced from 25% in 2005-26 to 5% in 2019-21 and average duration of breastfeeding has remained around 16 months. The percent of mother with 'not normal BMI' has declined from 58% in 2005-06 to 36% in 2019-21 and that of anemic mothers has marginally increased from 58% to 59%. Average years of schooling of mothers have increased from 5.18 years in 2005-06 to 7.55 years in 2019-21. The average score of BAI has also improved 4.21 to 5.29 during the same period implying that accessibility to basic amenities such as safe drinking water, clean cooking fuel and proper toilet facility have improved over the years. The table also have information on means and SDs of various explanatory variables included in this study.

Table1: Summary statistics for variables used in estimations

Variable	NFHS 3 (2005-06)			NFHS 4 (2015-16)			NFHS 5 (2019-21)		
	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD
Stunted	18057	0.48	0.500	86321	0.39	0.487	73070	0.35	0.478
Sex of Child (Girl)	23,093	0.48	0.500	117,659	0.48	0.500	106,880	0.48	0.500
Birth Order	48,100	2.62	1.811	244,549	2.27	1.470	221,256	2.15	1.338
Birth Interval	32,626	36.90	21.470	153,576	38.10	22.921	136,129	39.96	24.272
Weight at Birth (Underweight)	3,961	0.20	0.398	31,526	0.17	0.376	33,740	0.17	0.374
Breastfed (After 1 Day)	8,658	0.25	0.432	14,817	0.08	0.278	8,793	0.05	0.225
Duration Breastfed	47,828	16.73	11.369	189,156	15.91	12.609	177,814	16.25	12.985
BMI (Not Normal)	19,366	0.42	0.667	90,506	0.38	0.725	78,566	0.36	0.778
Anemia (Anemic)	24,929	0.58	0.494	134,965	0.56	0.496	126,126	0.59	0.492

	NFHS 3 (2005-06)			NFHS 4 (2015-16)			NFHS 5 (2019-21)		
Mother's Education	48,118	5.18	5.143	244,858	6.21	5.136	221,256	7.55	5.133
Wealth Status									
Poor	17,127	0.36	0.479	121,397	0.50	0.500	110,883	0.50	0.500
Middle	9,898	0.21	0.404	48,909	0.20	0.400	42,980	0.19	0.396
Rich	21,093	0.44	0.496	74,552	0.30	0.460	67,393	0.30	0.460
Caste									
GEN	13,925	0.30	0.459	42,834	0.18	0.387	35,066	0.17	0.373
SC	8,498	0.18	0.388	46,005	0.20	0.397	45,116	0.84	0.369
ST	7,766	0.17	0.375	49,814	0.21	0.407	44,727	0.22	0.417
OBC	15,835	0.34	0.475	95,923	0.41	0.492	84,543	0.40	0.491
Residence (Urban)	18,412	0.38	0.486	186,066	1.76	0.427	45,318	0.20	0.404
BAI	43,733	4.21	2.605	224,337	4.31	2.426	203,912	5.29	2.165

Source: Authors' calculation.

3.2. Concentration Index (CI)

Table 2 shows the normalized Concentration Indices (CIs) (Wagstaff type) for child stunting in India in 2005-06, 2015-16 and 2019-21. The CIs are -0.2510, -0.2551 and -0.2109 in 2005-06, 2015-16 and 2019-21 respectively. The negative values of CIs imply that the burden of child stunting has been higher among the disadvantaged households

over the years. The last column of the table shows the change in CI over the years. Surprisingly, from 2005-06 to 2015-16, the CI for stunting has increased by -0.0041 (2% increase). As compared to 2005-06, the CI has decreased by 0.0401 in 2019-21, which means that socioeconomic inequality in child stunting has reduced by 16% during this period.

Table 2: Normalized Concentration Index (Wagstaff) for child stunting in India, 2005-06, 2015-16 & 2019-21

Year	Index value	Robust SE	p-value	Change (compared to 2005-06)
2005-06 (NFHS 3)	-0.2510	0.0068	0.000	-
2015-16 (NFHS 4)	-0.2551	0.0034	0.000	-0.0041
2019-21 (NFHS 5)	-0.2109	0.0036	0.000	0.0401

Source: Authors' calculation.

3.3. Decomposition of Concentration Indices

Table 3 presents the results of decomposition of inequality in child stunting in India in 2005-06, 2015-16 and 2019-21. The table shows the CIs of regressors (Ck), the absolute and percentage contribution of the explanatory variables on CI and their changes. The negative CIs of determinates reveal that share of these determinants are more concentrated among people in lower economic status. It is evident that number of girl children, higher birth order, underweight children, occurrence of first breastfed after day-1, underweight mothers, prevalence of anemia among mothers, and number of SC, ST children are more concentrated among people in lower wealth status because all these determinants show negative CIs for the three NFHS rounds i.e. 2005-06, 2015-16 and 2019-21. In contrast, birth interval, mother's education and Basic Amenities Index (BAI) have been more concentrated among people in higher economic status in all three rounds of NFHS.

In addition, Table 3 depicts the absolute contribution of each determinant to socioeconomic inequality in child stunting. A positive (or negative) value indicates that the inequality in child stunting would decrease (increase) if the variable were to be equally distributed across socioeconomic groups. Among all determinants, the largest contributor to inequality is mother's education in all three rounds of NFHS (51%, 82% and 80% in 2005-06, 2015-16 and 2019-21 respectively). Positive values of CIs for mother's education in all three time points, although decreasing, suggest that the inequalities in mother's education are in favor of the privileged.

Another important contributor to socioeconomic inequality in child stunting is mother's BMI. Mother's underweight BMI is attributable to inequality by about 25%, 20% and 21% in 2005-06, 2015-16 and 2019-21 respectively. The CIs for underweight BMI are -0.2433, -0.2737 and -0.2608 for three time periods. The negative CIs over the periods suggest that the burdens of

underweight BMI are on underprivileged.

Further, inequality in birth order is significant contributor to socioeconomic inequality in child stunting with 22%, 17% and 15% contribution in 2005-06, 2015-16 and 2019-21 respectively. The negative CIs in three time periods suggest that the inequality in birth order is concentrated among the poor. Similarly, duration of breastfed is a significant contributor (with 15%, 14% and 10% respectively) over the periods and negative CIs indicate that inequality in duration of breastfed is among the poor.

Basic Amenities Index (BAI) has been a significant contributor to inequality in stunting over the periods. Its contributions have been 16%, 57% and 44% in 2005-06, 2015-16 and 2019-21 respectively. The positive CIs over the periods suggest that the inequality in BAI favored the richer households.

Other important contributors to socioeconomic inequality in stunting are child underweight and birth interval. Child underweight contributes about 9%, 3% and 7% over three NFHS rounds. The negative CIs imply that burden of underweight children have been among the poor over the periods. Inequality in birth interval favored the privileged section with CIs being positive for three time periods contributing 5%, 9% and 17%, respectively.

The last column of the Table 3 presents the change in absolute contribution of determinants to child stunting between the periods 2005-06 to 2019-21. It shows the factors for deterioration or improvement in CIs of stunting between 2005-06 and 2019-21. The changes in factors like urban residence, BAI, mother's education, birth interval and mother's anemia have widened the inequality in child stunting. In contrast, changes in caste, timing of first breastfed, duration of breastfed and mother's BMI have narrowed the inequality in stunting during that period.

Table 3: Decomposition of inequality in child stunting in India, 2005-06, 2015-16 and 2019-21

	2005-06 (NFHS 3)				2015-16 (NFHS 4)				2019-21 (NFHS 5)			
	E _k	CI _k	Contribution		E _k	CI _k	Contribution		E _k	CI _k	Contribution	
			Absolute	%			Absolute	%			Absolute	%
Sex of Child (Boy) ®												
Girl	-0.0357	-0.0177	0.0006	0	-0.0393	-0.0199	0.0008	0	-0.1023	-0.0096	0.0010	0
Birth Order	0.4498	-0.1239	-0.0557	22	0.4070	-0.1092	-0.0444	17	0.3486	-0.0899	-0.0314	15
Birth Interval	-0.5592	0.0209	-0.0117	5	-0.5449	0.0424	-0.0231	9	-0.6724	0.0515	-0.0346	17
Weight of Child at Birth (Normal) ®												
Underweight	0.2382	-0.0892	-0.0212	9	0.1756	-0.0506	-0.0089	3	0.1968	-0.0712	-0.0140	7
Time of first breastfed (within 1 Day) ®												
After 1 Day	0.0786	-0.2473	-0.0195	8	0.0077	-0.0388	-0.0003	0	0.0047	0.1181	0.0006	0
Duration of Breastfed	0.9617	-0.0393	-0.0378	15	0.9505	-0.0364	-0.0346	14	0.6851	-0.0292	-0.0200	10
Mother's BMI (Normal)®												
Underweight	0.2562	-0.2433	-0.0623	25	0.1841	-0.2737	-0.0504	20	0.1665	-0.2608	-0.0434	21
Mother's Anemia Status (Anemic) ®												
Not Anemic	-0.0160	-0.1461	0.0023	-1	0.1478	-0.1002	-0.0148	6	0.0888	-0.1293	-0.0115	5
Mother's Education (in completed years)	-0.3001	0.4220	-0.1267	51	-0.7274	0.2869	-0.2087	82	-0.7797	0.2156	-0.1681	80
Caste (GEN) ®												
SC	0.1294	-0.2002	-0.0142	6	0.1243	-0.1697	-0.0211	8	0.1630	0.3824	0.0623	-30
ST	0.0708	-0.4636	0.0027	-1	0.0389	-0.4060	-0.0158	6	-0.0126	-0.4127	0.0052	-2
OBC	-0.0058	0.0023	0.0002	0	0.1597	0.0576	0.0092	-4	-0.1428	0.0893	-0.0128	6
Sub Total			-0.0113	5			-0.0277	11			0.0548	-26
Residence Type (Rural) ®												
Urban	0.0839	0.6580	0.0552	-22	-0.1135	-0.6385	0.0725	-29	-0.0134	0.6258	-0.0084	4
BAI	-0.1336	0.2946	-0.0394	16	-0.5826	0.2505	-0.1459	57	-0.5561	0.1668	-0.0927	44
Total Observed			-0.3275	131			-0.4857	191			-0.3678	175
Residual			0.0782	-31			0.2315	-91			0.1580	-75
Total			-0.2493	100			-0.2542	100			-0.2098	100

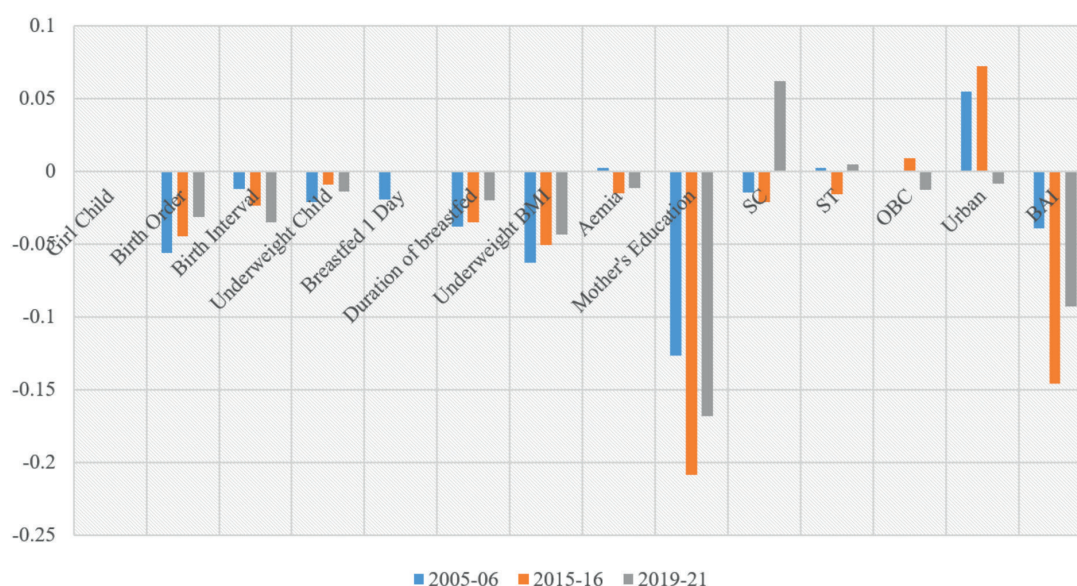
Source: Authors' calculation

Note: ® Reference Group, Ek and Ck refer to Elasticity and Concentration Index for kth determinant respectively.

Figure 2 shows the absolute contributions of different indicators over the three NFHS in India. The trends reveal that the contribution of birth order, underweight child, and duration of breastfed, mother's BMI and mother's anemia have been

decreasing over time whereas the contributions of birth interval have been increasing over the periods. The contribution of mother's education and BAI increased from 2005-06 to 2015-16 and then declined.

Figure 2: Absolute Contributions of determinants to socioeconomic inequalities in child stunting in India: 2005-06, 2015-16 and 2019-21



Source: Authors.

4. Conclusion and implications

This study has analyzed the trends and determinants of socioeconomic inequality in child stunting in India over the three NFHS rounds in three time points (2005-06, 2015-16 and 2019-21). The descriptive statistics illustrate a positive trajectory in reducing the prevalence of child stunting over the years which essentially implies an overall improvement in the nutritional status of children in India. However this progress is accompanied by inequalities across socioeconomic strata, as evidenced by the Concentration Index which consistently shows pro-rich inequality in child stunting.

The findings suggest that mother's education and provision of basic amenities (safe drinking water, clean cooking fuel and toilet facility) have profound contribution to make equal distribution

of child stunting. These findings are consistent with previous studies conducted in India (Singh, Srivastava & Upadhyay, 2019; Singh, Srivastava & Chauhan, 2020; Spears, Ghosh & Cumming, 2013). The role of educational level of women becomes more significant in the developing countries like India where educated women become more aware of health related issues. They can participate in income earnings and decision making process which directly or indirectly affect the maternal as well as child health. Thus, women's education becomes more significant when a developing country experiences a major spurt in growth rate of the economy and associated changes in the society (S. Singh et al., 2019).

The decomposition analysis show that more equitable distribution of safe drinking water, clean cooking fuel and toilet facilities contribute to

reduce child stunting in India. This implies that nutritional status is a useful endpoint for water and sanitation interventions and underscores the need to improve sanitation in developing countries like India (Checkley et al., 2004; S. K. Singh et al., 2020). In our study we included three indicators of basic amenities viz. improved drinking water, clean cooking fuel and toilet facilities, in variable BAI, which shows that improvement in BAI will reduce the child stunting in India significantly.

The mother's nutritional status (BMI and anemia) also have a significant contribution to child stunting. Reduction in inequality in mother's nutrition had led to reduction in inequality in child stunting. Similarly, reduction in inequality in duration of breastfeeding and birth order of child would bring down the inequality in child stunting in India.

The decomposition analysis highlight the complex interplay of the determinants to this inequality. Maternal education emerges as a key determinant, emphasizing the crucial role of empowering women through education in improving child health status. Moreover, access to basic amenities such as improved drinking water, clean cooking fuel and proper sanitation facilities emerges as another significant determinant influencing the distribution of child stunting, emphasizing the importance of holistic development interventions. After the launch of Swachh Bharat Mission in 2014, the government of India has built a significant number of latrines for individual households. Various studies have found that despite having access to latrines, many people prefer to defecate in open (Banda et al., 2007; Coffey et al., 2014). Thus, there is a need to bring a behavioral change through promotion of use of latrines among Indian masses. The study also highlights the pivotal role of maternal nutritional status, breastfeeding practices, and birth order in shaping child stunting, underscoring the need for targeted interventions to address these determinants.

Though the governments have made efforts to reduce socioeconomic inequality in child stunting, persistent challenges still remain in India. To address these challenges, multifaceted approaches need to be adopted and implemented. The government should make such policies that prioritize women education, healthcare access, sanitation infrastructure, and maternal nutrition. Equal distribution of basic amenities among the people to be ensured. By targeting these key determinants, policymakers can advance towards achieving more equitable and sustainable improvements in child nutrition in India.

References

- Banda, K., Sarkar, R., Gopal, S., Govindarajan, J., Harijan, B. B., Jeyakumar, M. B., Mitta, P., Sadanala, M. E., Selwyn, T., & Suresh, C. R. (2007). Water handling, sanitation and defecation practices in rural southern India: A knowledge, attitudes and practices study. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 101(11), 1124–1130.
- Checkley, W., Gilman, R. H., Black, R. E., Epstein, L. D., Cabrera, L., Sterling, C. R., & Moulton, L. H. (2004). Effect of water and sanitation on childhood health in a poor Peruvian peri-urban community. *The Lancet*, 363(9403), 112–118.
- Coffey, D., Gupta, A., Hathi, P., Khurana, N., Srivastav, N., Vyas, S., & Spears, D. (2014). Open defecation: Evidence from a new survey in rural north India. *Economic and Political Weekly*, 43–55.
- Hosseinpoor, A. R., Van Doorslaer, E., Speybroeck, N., Naghavi, M., Mohammad, K., Majdzadeh, R., Delavar, B., Jamshidi, H., & Vega, J. (2006). Decomposing socioeconomic inequality in infant mortality in Iran. *International Journal of Epidemiology*, 35(5), 1211–1219. <https://doi.org/10.1093/ije/dyl164>
- IIPS, I. C. F. (2021). National Family Health Survey (NFHS-5): 2019-21 India. Mumbai:

International Institute for Population Sciences (IIPS).

IIPS, I. C. F. (2017). National Family Health Survey (NFHS-4): 2016-17 India. Mumbai: International Institute for Population Sciences (IIPS).

IIPS, Orcm. (2007). National Family Health Survey (NFHS-3), 2005-06: India. Vol. I. Mumbai: International Institute for Population Sciences.

O'Donnell, O., O'Neill, S., Van Ourti, T., & Walsh, B. (2016). Conindex: Estimation of Concentration Indices. *The Stata Journal: Promoting Communications on Statistics and Stata*, 16(1), 112–138. <https://doi.org/10.1177/1536867X1601600112>

O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2007). Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and their Implementation. The World Bank. <https://doi.org/10.1596/978-0-8213-6933-3>

Priyanka, R., Vincent, V., Jini, M. P., & Saju, C. R. (2016). An assessment of the nutritional status of underfive children in a rural area of Thrissur district, Kerala, India. *Int J Community Med Public Health*, 3(12), 3479–3486.

Shiva Kumar, A. K. (2007). Why are child malnutrition levels not improving. Opinion-Leader Page Articles. *The Hindu*.

Singh, S. K., Srivastava, S., & Chauhan, S. (2020). Inequality in child undernutrition among urban population in India: A decomposition analysis. *BMC Public Health*, 20(1), 1852. <https://doi.org/10.1186/s12889-020-09864-2>

Singh, S., Srivastava, S., & Upadhyay, A. K. (2019). Socio-economic inequality in malnutrition among children in India: An analysis of 640 districts from National Family Health Survey (2015–16). *International Journal for Equity in Health*, 18(1), 1–9.

Spears, D., Ghosh, A., & Cumming, O. (2013). Open defecation and childhood stunting in India: An ecological analysis of new data from 112 districts. *PLoS One*, 8(9), e73784.

Speybroeck, N., Konings, P., Lynch, J., Harper, S., Berkvens, D., Lorant, V., Geckova, A., & Hosseinpoor, A. R. (2010). Decomposing socioeconomic health inequalities. *International Journal of Public Health*, 55(4), 347–351. <https://doi.org/10.1007/s00038-009-0105-z>

Svedberg, P. (2006). Declining child malnutrition: A reassessment. *International Journal of Epidemiology*, 35(5), 1336–1346.

UNICEF, World Health Organization & The World Bank. (2023), UNICEF-WHO-WB Joint Malnutrition Estimates: Levels and Trends of Malnutrition, <https://data.unicef.org/topic/nutrition/child-nutrition>, Accessed on 31st March, 2024

Wagstaff, A. (2005). The bounds of the concentration index when the variable of interest is binary, with an application to immunization inequality. *Health Economics*, 14(4), 429–432. <https://doi.org/10.1002/hec.953>

Wagstaff, A., Paci, P., & van Doorslaer, E. (1991). On the measurement of inequalities in health. *Social Science & Medicine*, 33(5), 545–557. [https://doi.org/10.1016/0277-9536\(91\)90212-U](https://doi.org/10.1016/0277-9536(91)90212-U)

Wagstaff, A., Van Doorslaer, E., & Watanabe, N. (2003). On decomposing the causes of health sector inequalities with an application to malnutrition inequalities in Vietnam. *Journal of Econometrics*, 112(1), 207–223.

Public Health Expenditure, Fiscal Space and Capacity of Indian States

Deyona Rose Saji¹ and S Madheswaran²

Abstract

This paper examines the role of macro-fiscal factors and the state's capacity in prioritising the public health expenditure of states in India through the lens of fiscal space. The Panel ARDL-PMG model reveals that the state's capacity is crucial in determining the public spending on health. The positive and significant long-run relationship between the government health expenditure and HDI indicates a need to create human capacities in the states to absorb higher expenditure by the government. The short run lagged values of fiscal deficits indicate positive and significant need to create fiscal capacity that enables the government to increase the public expenditure on health. The positive and significant relationship between the government health expenditure and own tax revenues and grants received from the Centre indicates the need to create bigger fiscal space among the states.

JEL Classification Codes: H72, H75, E62, I1

1. Introduction

The allocation of financial responsibilities and relationships is significant in a fiscal federal system like India. India's government (or public) expenditure is incurred at three levels: national level through the Union Budget, state level through State Budgets and local self-governments level from tied and untied grants from the central and state governments. Constitutional provisioning of health falls within the preview of state subjects, designating them primarily responsible for ensuring the availability and accessibility of essential health services. In general, states in India bear a greater responsibility for health expenditure than central government. For instance, "State accounts for 87 per cent of spending on social services and their share on education and healthcare spending is close to 90 per cent as compared to central government share which includes the spending through various Central Sector and Centrally Sponsored Schemes (CSS)" (Rao, 2022).

Economic growth and productivity are gaining momentum at global and national levels after the economic slowdown due to Covid-19 pandemic. Financing human development priorities stands at paramount importance for higher economic growth and reduction in regional disparities (Ghosh, 2006). They are critical components that need policymakers' attention to decrease poverty, improve welfare and capacitate human capital building. Government expenditure in India (combined Centre and states) on social services stands at 7.5 per cent of GDP in 2020-21. In particular, the share of spending on education and health is 2.9% and 1.6% of GDP respectively (Press Information Bureau of India, 2023), which is lower than the global standard of 6 per cent and 3 per cent respectively as prescribed by UNDP (1991). This shortage of public expenditure on social sector expenditure serves as an apparent indication of the fiscal limitations that the government faces in providing budgetary allocations for education and health. The primary difficulty encountered in funding human development arises from the structure and size of the budget and the political economy of prioritisation of the sector.

¹ Research Scholar, Center for Economic Studies and Policy, Institute for Social and Economic Change, Bengaluru-560072. E-mail: deyona2014@gmail.com

² Professor, Center for Economic Studies and Policy, Institute for Social and Economic Change, Bengaluru-560072.

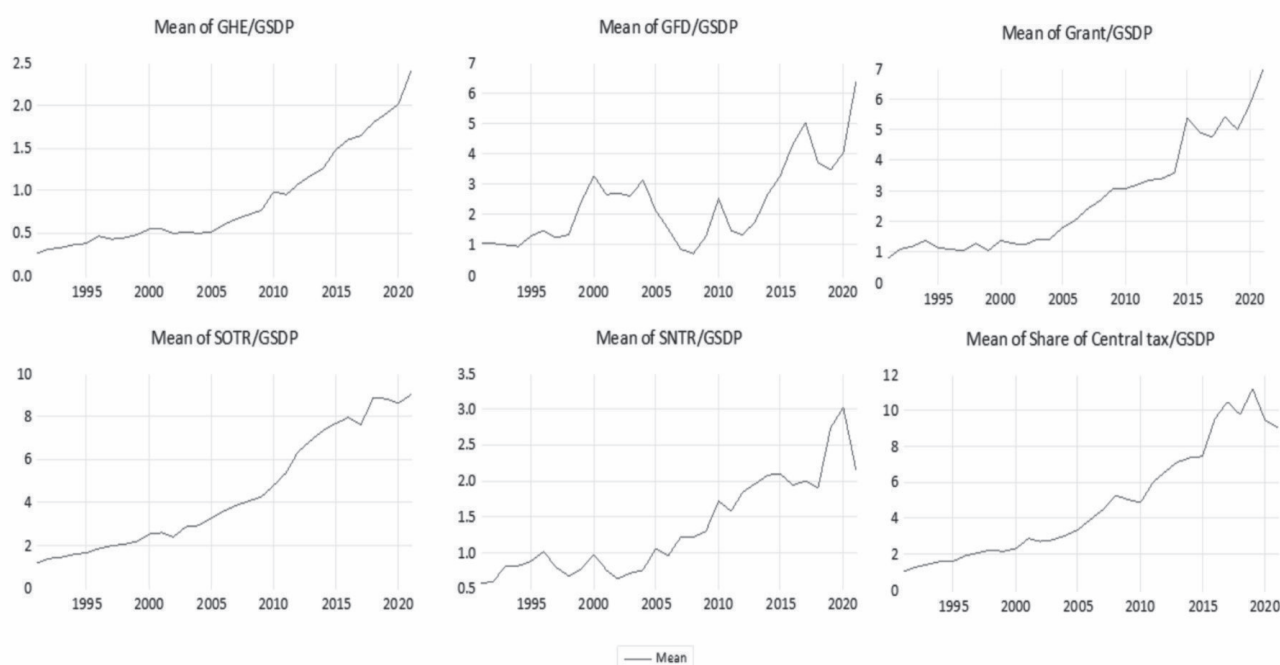
However, the government focuses on achieving fiscal consolidation in each of its budgets through the Fiscal Responsibility and Budget Management (FRBM) Act. The state government's fiscal consolidation mechanisms have made it challenging to allocate its resources for investing in human development. Hence, a comprehensive analysis of macro-fiscal parameters is required to understand the state's stance on prioritising health spending. The main purpose of this research is to analyse the growth and determinants of public financing and health in terms of budgetary priorities for expenditure. In the following discussion, we focus on how changes in the macro-fiscal factors affect the changes in health spending at state level in India.

2. Trends in Public Expenditure on Health in India

The allocation of public expenditure on health

is important to analyse expenditure priority and its share in GSDP is useful to determine a state's capacity to generate its economic resources and state's efforts to spend on health. We analyse the trends in public expenditure on health by categorising the states into two, based on the categorisation adopted from financing of the National Health Mission: High Focus states and Non-High Focus states. This categorisation is based on the state's performance on health indicators and economic performance. It is adopted as our analysis focuses on the financing of health. States such as Assam, Bihar, Madhya Pradesh, Odisha, Rajasthan, and Uttar Pradesh are High Focus large states (henceforth, HF states) and states such as Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu, and West Bengal are Non-High Focus large states (henceforth, NHF states).

Figure 1: Trends in mean public expenditure on health in High Focus states 1990-91 to 2020-21



Source: Authors' own calculation based on RBI-States Finances data.

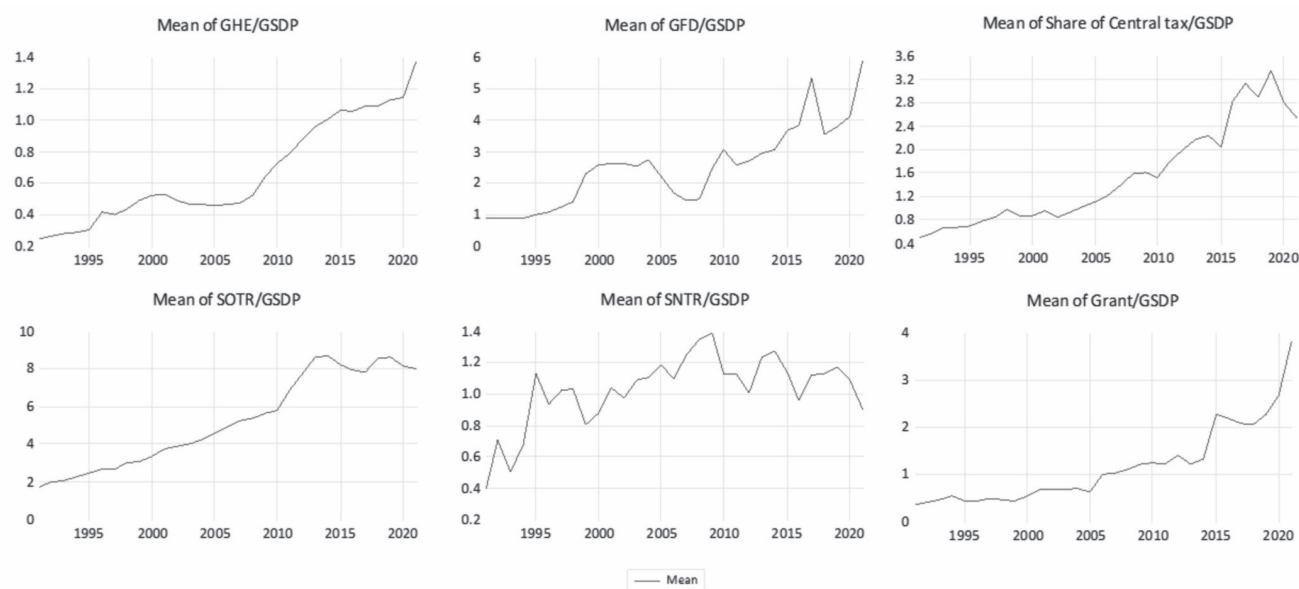
Notes: Y-axis measures the average of the variables in the percentage of GSDP. GHE is Government Health Expenditure, GFD is Gross Fiscal Deficit, Grant is Grants received from Centre, SOTR is State's own tax revenue, SNTR is State's non-tax revenue. Detailed explanation on each of these variables can be found in Table 1.

The trends in mean health expenditure and macro-fiscal variables for HF states are presented in Figure 1. As compared to NHF states, health receives very low priority in HF states. The states such as Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Maharashtra, Punjab, Tamil Nadu, and West Bengal exhibit high per-capita spending but their share in their GSDP is lower than Assam, Bihar, Madhya Pradesh, Odisha, Rajasthan, and Uttar Pradesh. The Centre's share of health expenditure is on primary care, whereas secondary and tertiary health sectors are financed by the states (Berman & Ahuja, 2008). The health care funding concentrates on direct spending on health rather than on items like water supply and sanitation which indirectly affect health. The economic classification of the structure of spending pattern reveals that 90 per cent of spending goes to staffing expenses and states with a higher share of the elderly population tend to spend more on health.

Nevertheless, merely analysing the trends and differential spending among the states towards health does not explain the state's priorities in spending. Consequently, the differences in the state's capacity can also be attributed to different fiscal-financial positions of the state. This can also be attributed to the state's macro-fiscal capacities because the revenue generation, grants and tax

devolution received from the Centre also affect the expenditure decision by the government.

The fiscal factors like the state's own resources are needed to increase the capacity of the states. The mean GFD as a percentage of GSDP among the HF states (Figure 1) and NHF states (Figure 2) shows that NHF states have remained below 3 percent till 2014 and have seen an increase and a high of 5.3 percent in 2017. On the other hand, in HF states, it has grown above 3 percent in 2000 and 2004, except in 2008 (8 percent). The state's revenue capacity in terms of own tax revenue gives a similar picture of a relatively steady increase in both HF and NHF states. The non-tax revenue also shows the same trends in both HF and NHF states except for 2019 where NHF states show 2.74 percent of non-tax revenue compared to that of 1.17 percent of non-tax revenue of HF states. Grants from the Centre and Centre tax devolution towards states are very important for the states as the state's revenue generation capacity is very limited. It is observed that NHF states receive a higher share of grants and a higher share of central taxes. A major increase in grants and tax share in both the categories of the states is seen from 2014 due to changes in the institutional structure where the erstwhile Planning Commission was replaced with NITI Aayog, and the grants distributed according to the Finance Commission formulas.

Figure 2: Trends in mean public expenditure on health in Non-High Focus states 1990-91 to 2020-21

Source: Authors' own calculation based on RBI-States Finances data.

Notes: Y-axis measures the average of the variables in the percentage of GSDP. GHE is Government Health Expenditure, GFD is Gross Fiscal Deficit, Grant is Grants received from Centre, SOTR is State's own tax revenue, SNTR is State's non-tax revenue. Detailed explanation on each of these variables can be found in Table 1.

Fiscal and macro-economic changes, such as, the pre-reform crises in 1991, the implementation of the Fifth Pay Commission in 1998, the introduction of the FRBM Act 2003, the implementation of the Sixth Pay Commission in 2008 and NRHM 2005 have affected the allocation and spending on health. Hooda, (2013) argues that the disparities across the states occur in fiscal disabilities resulting in fiscal limitations of the state leading to differential healthcare service provision. It is also evident that health receives a lower priority for most states compared to education.

3. Theoretical backdrop

Several pieces of literature have tried to underpin the concept of fiscal space. Heller, (2005) defines fiscal space as "room in a government's budget that allows it to provide resources for a desired purpose without jeopardizing the sustainability of its financial position or the stability of the economy". As India is striving to enhance its achievement towards Sustainable Development

Goal objectives, it becomes significant to achieve it within its revenue and financing constraints. In this context, apprehensions have emerged about whether macroeconomic constraints limit the spending of government towards health.

The sectoral effect of the government's fiscal position on health is significantly influenced by their classification as merit goods. Moreover, the effect of public spending on overall health leads to crowding out effect, which occurs from the competing demand for public expenditure. Tandon et al., (2014); Tandon & Cashin, (2010) approach to conceptualising reprioritisation of the government expenditure based on the fiscal space approach can be represented by following intertemporal budget constraint approach.

$$G_t + r_t B_{t-1} = T_t + B_t + A_t + O_t \quad (1)$$

where B is public debt, G is government expenditure, T is revenue and r is rate of interest. A represents grants and O represents other sources

of funds (non-tax revenues). The macro-economic conditions that are conducive to an economy include an increase in revenue generation, reallocation of government funds to priority sectors and augmenting sector-specific resources earmarked in taxation. These macroeconomic conditions depend on broader macroeconomic policies and conditions.

Another important theoretical consideration in this direction of public finance is the “flypaper effect”. It refers to the impact of grants received by the sub-national government in its expenditure decisions. It recommends that unconditional transfers received by a subnational government have a greater stimulating effect than tax relief (Lago et al., 2022). It suggests that “the grants lead to higher levels of service provision than would be in case if the payment was directly made to individual” (Ahmad & Craig, 1997). The disincentive effect brings out the equalisation effect among the states. Musgrave, (1961) brings various equalisation plans that would incentivise or disincentive the sub-national governments to increase their own tax revenues. Disincentive effects may lead to differences in redistributive effects as lowering taxes may lead to differences in the indifference curve of a community (Scott, 1952).

Leveraging the theoretical footing of the intertemporal budget constraint in equation (1), a dynamic expenditure framework can be constructed to capture the niceties of macro-fiscal variables. However, a significant research gap exists in terms of rigorous attention to identifying the interstate variations on absorption to the macro-fiscal shift in terms of their budgetary allocation towards health. Despite this, the influence of factors heterogenous to each state must be accounted for to incorporate the state’s capacity to determine the expenditure on health. We call it the “absorptive capacity of the states”. Heller, (2006) raises the issue of “whether a government can ‘absorb’”, as it enlarges the scope of the existing skills both physical and human to effective utilisation of public spending.

A dynamic approach is used to represent the absorptive capacity of the state along with fiscal capacity we use variables such as lagged values of fiscal deficit, lagged values of government spending on health and lagged values of Human Development Index (HDI). The changes in health and educational sector expenditure are examined and linked to the macroeconomic variables. The fund allocated to health relies on total resources availability of the government versus the sectoral priorities and ‘absorption capacity’ of state (Press Information Bureau of India, 2016). Thus, it can be argued that the spending should not only be increased in nominal terms but also the absorptive capacity of the states should be increased.

The literature has focused on how the aggregate revenue capacity of the state has influenced the proportion of government spending. Our study attempts to incorporate the state’s capacity to decide the spending on health.

4. Empirical Literature Survey on Priorities of Public Expenditure on Health

The discussion on the structure and size of the budget here unfolds through understanding the macro-fiscal conditions of the states. The spending towards human development through public spending has a significant effect on economic growth. The study in advanced Asian economies by Mundle, (1998) suggests that the provisioning of public financing in health and education leads to a high growth rate. The study by Purohit, (2012) emphasises that the priorities of public spending should change towards post-primary education and preventive health care. The disparities across the states occur in fiscal disabilities resulting in fiscal limitations of the state leading to differential healthcare service provision (Hooda, 2013). The analysis of the size and trend of spending priorities of the states brings out not only the share of public expenditure on human development priority areas but also the capacity of the states to raise their macro-fiscal position. Literature has recorded various factors determining the fiscal space of a

country, such as an increase in revenue generation, reallocation of government funds to priority sectors and augmenting sector-specific resources earmarked taxation. Studies on fiscal space for health have unveiled a significant correlation between growth and budget reprioritisation. State's own tax revenue has a significant influence on developing countries in financing their health (Lu et al., 2010). The relation between the per-capita income and health spending Taylor & Dessai, (2023) also highlights that the state's own revenue has a positive impact on the per-capita health spending and health as a necessary good consistent with the findings of Hooda, (2016). Furthermore, the analysis of the sub-national levels of fiscal consolidation highlights that reduced vertical transfers are negatively impacting sub-national governments (Chakraborty et al., 2009). The study by Kaur et al., (2013), finds fiscal deficit with one of the previous period lag as a factor influencing social sector spending. The effect of GSDP and revenue receipt also affect the determination of health whereas internal debt has an insignificant impact on determining health expenditure (Khan, 2022). However, a significant research gap exists in terms of estimation of interstate variations on absorption to the macro-fiscal shift in terms of their budgetary allocation towards health.

5. Methodology

5.1. Functional form and Variables

The dataset comprises periods from 1990-91 to 2018-19³ for 15 major states in India. To examine the fiscal space and absorption capacity of the states, the functional specification is formulated as follows.

$$GHE = f(OTR, NTR, Grants, Tax Transfers, FD_{t-i}, HDI_{t-i}, GHE_{t-i}, Doc1000, Pop) \quad (2)$$

Here, the Government Health Expenditure (GHE) is a function of state's own tax revenue (OTR), state's nontax revenue (NTR), fiscal transfer representing the grants received from the Centre and tax devolution as the tax transfers received from the Centre, fiscal deficit (FD_{t-i}) representing the debt conditions of the state and its fiscal discipline, We include the lagged value of the GHE and GEE as a proxy for capacity of state governments and its prioritisation on health. Human Development Index (HDI) [UNDP, 2013] report suggests a positive correlation between current values of HDI and previous public expenditure per capita on health. In our analysis, we consider lagged values of HDI to analyse the existing human development capacity of a state and previous year's priorities of public spending. Such a relationship represents how the existing and past human development capacity in a state affects the present spending on health. Variables such as OTR, NTR, Grants, Tax Transfers and Fiscal Deficit are expressed as a percentage of the GSDP of states. Pop represents the population of states and is used as a control variable. Although this analysis primarily examines state-level expenditures, it also considers the revenue transfers from the Centre to state and local bodies when accounting for revenue transfers. This highlights the importance of states having the capability to sustain or enhance their expenditures.

5.2. Rationale behind using PMG estimates

In our dataset, T denotes time and comprises 28 years (1990-91 to 2018-19) and N denotes 15 cross-sectional variables (states). This implies that T is greater than N ($T > N$) and traditional dynamic panel data models are not appropriate as they will lead to instability in the model (Pesaran et al., 1999). In order to estimate the non-stationary heterogeneous panel when $N > T$, we use the Panel Auto Regressive Distributed Lag (ARDL) Model by using the Pooled Mean Group (PMG) Method (Pesaran et al., 1999).

³ The years after 2019 are omitted due to inconsistent variations in data caused by the impact of Covid-19, as they create stationarity issues in HDI values. The pandemic has affected the health (mortality indicators) and income indicators which are the components of HDI. Thus, the values of HDI declined after 2019 which led to stationarity issues in the data making it difficult to analyse the data. Hence those data points are omitted.

In our dynamic panel situation where both current and lagged values are considered, we should account for this cross-section specific and averaged (mean) coefficients across the panel. PMG estimates account for both the elements of pooled OLS and group mean estimates. PMG estimates enforce the constraint that long-run coefficients are identical while allowing the short-run coefficients and adjustment coefficients to vary across the cross-sectional dimension (Baltagi, 2021). Thus, it accounts for the cross-sectional differences by considering the mean of this short-run and adjustment coefficient. It allows for the error variables to differ across groups. The model also gives estimates of cross-sectional

unit coefficients and considers that long-run (but not short-run) estimators are the same across the groups. The technical details of PMG model and basic test results of Panel Unit root, Cross-sectional Dependence and Cointegration tests are given in **Annexure 1 and 2**.

6. Results and Discussions

6.1. Variables and descriptive statistics

To start with, the definition, data sources and descriptive statistics of variables used in the estimation of PMG model are summarised in Table 1.

Table 1: Description of the Variables, Data Sources and Descriptive Statistics

Description of the variables	Data Sources
Government Health Expenditure (GHE) Sum of expenditure on medical and public health and family welfare. Includes expenditure on revenue expenditure and capital outlay.	RBI-State Finances
State's own tax revenue (OTR) Induces taxes on income, property and capital transactions and commodity and services	RBI-State Finances
State's non-tax revenue (NTR) State's own non-tax revenue includes interest receipts, dividends and profits, revenue from general, social and economic services	RBI-State Finances
Grants Total grants received from the Centre on the heads of State Plan Schemes, Central Plan Schemes, Centrally Sponsored Schemes, NEC/Special Plan Schemes, Finance Commission Grants, State's disaster response funds and other grants.	RBI-State Finances
Tax Share Tax share represents the tax devolution received from the Centre by the states. These are various taxes that are collected by the Centre and distributed among the states. It includes the heads such as Central Goods and Service Tax, corporation tax, income tax, Estate duties, customs, etc	RBI-State Finances
Fiscal Deficit Fiscal deficit is an indicator of delay in cautious fiscal management. Gross Fiscal deficit is the difference between gross fiscal revenue and gross fiscal expenditure.	RBI-State Finances EPWRFIT

Description of the variables		Data Sources			
Human Development Index (HDI) Interpolated data (Smits & Permanyer, 2019)		Global Data Lab			
Doctor per 1000 population (Doc1000) Doctors and Surgeons registered with Medical Councils/Population*1000		No of Doctors-EPWRFIT Population-RBI			
Descriptive Statistics of the Variables					
Variable	Observation	Mean	Std. Dev.	Minimum	Maximum
GHE	435	0.691	0.460	0.135	2.478
GFD	435	2.256	1.578	-1.575	14.981
SOTR	435	4.654	2.683	0.654	15.751
SNTR	435	1.118	0.772	0.154	4.205
GRANTS	435	1.584	1.471	0.204	8.495
TAX TRANSFERS	435	2.682	2.921	0.227	18.919
HDI	435	0.544	0.085	0.379	0.774
DOCTORPER1000	435	4.386	3.231	0.064	21.144
POPULATION	435	6.433	3.981	1.630	22.422

Source: Descriptive statistics Authors' own calculation.

Table 1 presents the description of variables used in the PMG model and the source of the data along with the descriptive statistics. It is observed that mean and deviation in population is high

among the variables followed by doctor per 1000 population, SOTR, tax transfers and GFD. Higher deviations in doctors per 1000 population indicate the heterogeneity across the states in the health care providers existing among the states.

6.2. Results of PMG model

Table 2: Results for PMG estimation for Health on High focus and Non high focus states

Variable	High focus states PMG (3,2,3)	Non-High Focus states PMG (3,4,4)
Long-run (Pooled) Coefficients		
D(GFD)	0.06 *** (0.015)	0.053 *** (0.004)
D(HDI)	-14.026 *** (4.417)	1.949 ** (0.852)
C	-0.061 (0.048)	0.004 (0.013)
Short-run (Mean-Group) Coefficients		
ECMt-1	-0.569 ** (0.264)	-1.255 *** (0.416)
D(GHE (-1),2)	-0.716 *** (0.183)	0.088 (0.238)
D(GHE (-2),2)	-0.354 ** (0.15)	-0.059 (0.09)
D(GFD,2)	-0.001 (0.011)	0.003 (0.026)
D(GFD (-1),2)	0.009 (0.019)	0.034 (0.031)
D(GFD (-2),2)		0.018 (0.017)
D(GFD(-3),2)		0.023 (0.026)

Variable	High focus states PMG (3,2,3)	Non-High Focus states PMG (3,4,4)
D(HDI,2)	2.57 (4.761)	-2.557 (5.077)
D(HDI(-1),2)	2.365 (4.159)	-5.749 (3.597)
D(HDI(-2),2)	2.769 (7.849)	-5.886 (5.09)
D(HDI(-3),2)		2.018 (4.004)
D(SOTR)	-0.014 (0.045)	0.059 *** (0.012)
D(SNTR)	0.092 ** (0.038)	-0.02 (0.024)
D(Grants)	0.068 ** (0.031)	0.067 *** (0.017)
D(Tax Transfers)	0.046 (0.029)	0.081 (0.112)
D(Doc 1000)	0.918 (0.951)	0.037 (0.111)
D(Pop)	0.543 ** (0.23)	-0.552 (0.263)

Source: Authors' own calculation.

***, ** and * denote the significance at the 1%, 5% and 10% levels, respectively. SE in the parenthesis.

Table 2 gives the results of the PMG model by HF and NHF states. The error correction coefficient (ECMt-1) value in HF states is -0.569, suggesting it is a negative and significantly stable long-run relationship and indicates that 56 per cent of disequilibrium is achieved in the current period. In the NFH focus states the value of ECMt-1 in the model is -1.255. It indicates an oscillatory convergence path. However, this error correction term is negative and falls within the unit circle of -2. This pooled mean group estimator's error correction coefficient suggests that the dynamic stability condition may not hold correctly for some states. It represents dynamic stability is not achieved directly but by an oscillatory convergence (Loayza & Ranciere, 2005; Narayan & Smyth, 2006). The lags in the model are selected according to the Akaike Information Criteria (AIC) lag selection criteria.

The long-run coefficient indicates an average effect of changes between government health expenditure and fiscal deficit/HDI. The positive and significant values of the fiscal deficit in both groups in the long run indicate that the states with higher fiscal deficits have higher levels of spending towards the health sector. The magnitude of the average fiscal deficit is observed to be

higher among the HF states where one percent of gross fiscal deficit will lead to 0.06 percentage of government health expenditure. It shows that in the long run, states borrow to increase their spending towards health as these deficits might also help in prioritising their health expenditures. It indicates the need to improvise the fiscal capacity of the state to prioritise its health expenditure.

HDI indicates the state's capacity to absorb the current spending. The long-run coefficients of HDI are significant for both HF and NFH states. In addition to this, the existence of a cointegrating relationship and a significant error correction term identifies government expenditure and HDI has a significant long-run relationship similar to the results observed in the literature (Patel & Annapoorna, 2019; Ruzima & Veerachamy, 2023).

HDI shows a positive impact on government health expenditures in NFH states. It indicates that in the long run, the state's capacity as represented by human development positively affects the expenditure made by the government in NHF states. However, it shows a negative relationship between HDI and government health expenditure in HF states, where the improvements in HDI lead to a decrease in government health expenditure. The mean value of HDI is lower in HF states than that of NHF states. These counter-factual

relations can be explained by the existing human development disparities in the states like Assam, Bihar, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh. Despite these states allocate a higher share of their GSDP to health expenditure (e.g. 1.91 percent in 2019), but their HDI remains low (e.g. 0.60 in 2019). For a better understanding, in contrast to this a comparison to the NHF states, where lower share of health expenditure (e.g. 1.12 percent in 2019) corresponds to a higher HDI value (e.g. 0.69 in 2019). Another significant factor can be the composition of the younger population in HF states such as Bihar, Uttar Pradesh and Rajasthan (Youth in India-2022, 2022) leading to different healthcare demands concentrating on preventive health and health insurance. The NHF states demands curative and super-speciality care where older population is more. Thus, allocation to health expenditure may consider the existing human development capacity of the states to absorb the spending undertaken by the states if not this may lead to inefficiencies in spending. It is also significant to note that NHF states exhibit low per-capita health expenditures. However, the lagged short-run coefficient of HDI indicates a negative but insignificant relation in the short run. This is because in the short run observing the human development outcomes is difficult.

In the short run coefficients, the lagged values of health expenditure show a negative and significant relationship only for HF states, which indicates that the past values of the public health expenditure are negatively affecting the current health spending. It suggests a change in the government's preferences on health spending, over time the states have decreased their spending towards health. The previous studies such as D. K. Behera & Dash, (2018) and Lu et al., (2010) show a conflicting relationship to our results. However, the former study mentioned above was limited to the period of 2014 only and the latter study mentioned above explained a cross-country analysis. Hence, the differences in changes in health policies after 2014, such as National Health

Policy 2017, increased the share of government health expenditure, popularising vaccinations to preventive health such as the Universal Immunisation program, which led to changes in healthcare demand and increased public spending towards health in certain years. These changes in government priorities towards health lead to a negative relationship with the lagged values of health expenditure in our analysis.

Fiscal space analysis of revenue capacity of the government points to higher revenue capacities of the states indicating the higher fiscal space through which the government can prioritise health without resorting towards deficits. The macro-fiscal variables in the short run, the grants are positive and significant for both HF and NHF states. The higher magnitude of the value of grants from the Centre over tax revenues indicates that the states will prioritise health when their fiscal space expands through grants. Own tax revenue is positive and significant for NHF states and non-tax revenue is positive and significant for NHF states. This indicates the need to expand fiscal space in states and it becomes significant in determining the health expenditures. This relation is consistent with the results of D. K. Behera & Dash, (2019b). This relationship between the macro-fiscal variables and government health spending signifies the need to expand the fiscal space by increasing these macro-fiscal variables to allocate its share towards healthcare. Another variable which determines the state's absorptive capacity is the doctor per 1000 population, it shows a positive and significant relation between the health expenditure in HF states indicating the significance of developing the physical capacity needed to absorb the current government spending.

It is observed in health spending that there exist positive and significant long-run relationships to fiscal deficits. However, it is also observed that the macro-fiscal variables such as grants, and own tax revenue play a positive and significant role in determining health expenditure. The adoption of the FRBM Act by every state

have made it a mandate for states to achieve fiscal consolidation and reduce their fiscal deficit. Thus, the existence of fiscal space creation through the allocation of grants to the states and strategies and policies to improve the revenue-generating capacity of the state is needed. However, achieving macroeconomic stability by reducing fiscal deficit should not lead to a change in the priorities of the state.

7. Conclusion and Policy Implications

The analysis through the Panel ARDL PMG model reveals that the state's capacity is crucial to determine the spending towards health. The positive and significant long-run relationship between the government health expenditure and HDI in determining the priorities of the state towards health. It indicates the need to create both fiscal and human as well as infrastructural capacity in the states. The existence of variations among the HF and NHF states on HDI capacities reflects on its government and health expenditures. The macro-fiscal variables indicate the need to strengthen the fiscal space in the states. The positive and significant relationship between the government health expenditure and own tax revenues and grants received from the Centre indicates the need to create fiscal space among the states to prioritise public spending.

Achieving fiscal consolidation is a long-term goal of a rule-based fiscal condition adopted through the FRBM Act. It can be achieved by reducing the fiscal deficit by increasing revenue or by curtailing expenditure. However, our empirical results show that the fiscal deficit is positively and significantly affecting spending towards health in the long run. Increasing the state's own revenue capacity is necessary as it also shows a positive and significant relation and financing towards health is heavily dependent on grants from the Centre and revenue generated. Although expenditure reduction by the states is not a preferable option, it can be achieved by increasing the efficiency of public expenditure as it affects the population

relying on public services. The reorientation of the spending towards health through increasing efficiency and equity, coupled with changes in the public finance management system through monitoring of budget data increases the potential for growth and human development.

References

- Ahmad, E., & Craig, J. (1997). 4 Intergovernmental Transfers. In *Fiscal Federalism in Theory and Practice*. International Monetary Fund. <https://www.elibrary.imf.org/display/book/9781557756633/ch004.xml>
- Balodi, B., & Srivastava, A. (2021). Government Expenditure on Education: A Study of Centre and States in India. *Educational Quest-An International Journal of Education and Applied Social Sciences*, 13(3), 227–237. <https://doi.org/10.30954/2230-7311.3.2021.7>
- Baltagi, B. H. (2021). *Econometric Analysis of Panel Data*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-53953-5>
- Barro, R. J. (1989). The Ricardian Approach to Budget Deficits. *The Journal of Economic Perspectives*, 3(2), 37–54.
- Behera, D. K., & Dash, U. (2017). Effects of economic growth towards government health financing of Indian states: An assessment from a fiscal space perspective. *Journal of Asian Public Policy*, 12, 1–22. <https://doi.org/10.1080/17516234.2017.1396950>
- Behera, D. K., & Dash, U. (2018). The impact of macroeconomic policies on the growth of public health expenditure: An empirical assessment from the Indian states. *Cogent Economics & Finance*, 6(1), 1435443. <https://doi.org/10.1080/23322039.2018.1435443>
- Behera, D. K., & Dash, U. (2019a). Impact of macro-fiscal determinants on health financing: Empirical evidence from low-and middle-income

- countries. *Global Health Research and Policy*, 4(1), 21. <https://doi.org/10.1186/s41256-019-0112-4>
- Behera, D. K., & Dash, U. (2019b). Prioritization of government expenditure on health in India: A fiscal space perspective. *Socio-Economic Planning Sciences*, 68, 100667. <https://doi.org/10.1016/j.seps.2018.11.004>
- Behera, P. K., & Khatei, R. (2018). An Analysis of Public Finance on Education Sector in India. *VISION : Journal of Indian Taxation*, 5(2). <https://doi.org/10.17492/vision.v5i2.14521>
- Berman, P., & Ahuja, R. (2008). Government Health Spending in India. *Economic and Political Weekly*, 43(26/27), 209–216.
- Bernheim, B. D. (1989). A Neoclassical Perspective on Budget Deficits. *The Journal of Economic Perspectives*, 3(2), 55–72.
- Bravo, A. B. S., & Silvestre, A. L. (2002). Intertemporal sustainability of fiscal policies: Some tests for European countries. *European Journal of Political Economy*, 18(3), 517–528. [https://doi.org/10.1016/S0176-2680\(02\)00103-9](https://doi.org/10.1016/S0176-2680(02)00103-9)
- Chakraborty, P., Mukherjee, A. N., & Amarnath, H. K. (2009). Macro Policy Reform and Sub-National Finance: Why Is the Fiscal Space of the States Shrinking? *Economic & Political Weekly*, 44(14).
- Diamond, P. A. (1965). National Debt in a Neoclassical Growth Model. *The American Economic Review*, 55(5), 1126–1150.
- Durairaj, V., & Evans, D. B. (2010). Fiscal space for health in resource-poor countries. *The World Health Report Background Paper No. 41*.
- Furuoka, F., Yee, B. L. F., Kok, E., Hoque, M. Z., & Munir, Q. (2011). Determinants of Health Care Expenditure: World Bank, 8.
- Ghosh, M. (2006). Economic Growth and Human Development in Indian States. *Economic & Political Weekly*, 41(30). <https://www.epw.in/journal/2006/30/special-articles/economic-growth-and-human-development-indian-states.html>
- Heller, P. S. (2005). Back to Basics—Fiscal Space: What It Is and How to Get It. *Finance and Development | F&D*, 42(2). <https://www.imf.org/external/pubs/ft/fandd/2005/06/basics.htm>
- Heller, P. S. (2006). The prospects of creating ‘fiscal space’ for the health sector. *Health Policy and Planning*, 21(2), 75–79. <https://doi.org/10.1093/heapol/czj013>
- Hooda, S. K. (2013). Changing Pattern of Public Expenditure on Health in India: Issues and Challenges. ISID-PHFI Collaborative Research Programme.
- Hooda, S. K. (2016). Determinants of Public Expenditure on Health in India: A Panel Data Analysis at Sub-National Level. *Journal of Quantitative Economics*, 14(2), 257–282. <https://doi.org/10.1007/s40953-016-0033-8>
- Kaur, B., Misra, S., & Suresh, A. K. (2013). Cyclicity of Social Sector Expenditures: Evidence from Indian States. *Reserve Bank of India Occasional Papers*, 34(1 & 2).
- Khan, B. (2022). Determinants Of Public Health Expenditure In Some Selected States Of India: A Panel Data Approach. 6(10), 1636–1646.
- Koshima, Y., Harris, J., Tieman, A. F., & Sanctis, A. D. (2021). The Cost of Future Policy: Intertemporal Public Sector Balance Sheets in the G7. *IMF Working Papers*, 2021(128). <https://doi.org/10.5089/9781513573335.001.A001>
- Lago, M. E., Lago-Peñas, S., & Martinez-Vazquez, J. (2022). On the effects of intergovernmental grants: A survey. *International Center for Public Policy, Working Paper 22-03*. <https://doi.org/10.1007/s10797-023-09816-7>

- Loayza, N., & Ranciere, R. (2005). Financial Development, Financial Fragility, and Growth. IMF Working Papers, 32.
- Lu, C., Schneider, M. T., Gubbins, P., Leach-Kemon, K., Jamison, D., & Murray, C. J. (2010). Public financing of health in developing countries: A cross-national systematic analysis. *The Lancet*, 375(9723), 1375–1387. [https://doi.org/10.1016/S0140-6736\(10\)60233-4](https://doi.org/10.1016/S0140-6736(10)60233-4)
- Mohanty, R. K., & Behera, D. K. (2020). How Effective is Public Health Care Expenditure in Improving Health Outcome? An Empirical Evidence from the Indian States. National Institute of Public Finance and Policy New Delhi, Working Paper No. 300. https://nipfp.org.in/media/medialibrary/2020/03/WP_300_2020.pdf
- Mukherjee, S., Chakraborty, D., & Sikdar, S. (2014). Three Decades of Human Development across Indian States: Inclusive Growth or Perpetual Disparity? National Institute of Public Finance and Policy New Delhi.
- Mundle, S. (1998). Financing human development: Some lessons from advanced Asian countries. *World Development*, 26(4), 659–672. [https://doi.org/10.1016/S0305-750X\(98\)00004-7](https://doi.org/10.1016/S0305-750X(98)00004-7)
- Musgrave, R. A. (1961). Approaches to A Fiscal Theory of Political Federalism. In *Public Finances: Needs, Sources, and Utilization* (pp. 97–134). Princeton University Press.
- Narayan, P. K., & Smyth, R. (2006). What Determines Migration Flows From Low-Income To High-Income Countries? An Empirical Investigation Of Fiji–U.S. Migration 1972–2001. *Contemporary Economic Policy*, 24(2), 332–342. <https://doi.org/10.1093/cep/byj019>
- Patel, G., & Annapoorna, M. S. (2019). Public Education Expenditure and Its Impact on Human Resource Development in India: An Empirical Analysis. *South Asian Journal of Human Resources Management*, 6(1), 97–109. <https://doi.org/10.1177/2322093718813407>
- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, 94(446), 621–634. <https://doi.org/10.2307/2670182>
- Press Information Bureau of India. (2016). Healthcare in India. Government of India Ministry of Health and Family Welfare. <https://pib.gov.in/newsite/PrintRelease.aspx?relid=154292>
- Press Information Bureau of India. (2023). Share of government health expenditure in total health expenditure increases from 28.6 per cent in FY14 to 40.6 per cent in FY19. Ministry of Finance. <https://pib.gov.in/pib.gov.in/Pressreleaseshare.aspx?PRID=1894902>
- Purohit, B. C. (2012). Budgetary Expenditure on Health and Human Development in India. *International Journal of Population Research*, 2012, 1–13. <https://doi.org/10.1155/2012/914808>
- Rahman, T. (2008). Determinants of public health expenditure: Some evidence from Indian states. *Applied Economics Letters*, 15(11), 853–857. <https://doi.org/10.1080/13504850600770970>
- Rangarajan, C., & Srivastava, D. K. (2005). Fiscal Deficits and Government Debt: Implications for Growth and Stabilisation. *Economic and Political Weekly*, 40(27), 2919–2934.
- Rao, M. G. (2022). *Studies in Indian Public Finance*. Oxford University Press. <https://india.oup.com/product/studies-in-indian-public-finance-9780192849601>
- Ruzima, M., & Veerachamy, P. (2023). The impact of public spending in education and health on human development in India. *Journal of the Asia Pacific Economy*, 28(2), 390–403. <https://doi.org/10.1080/13547860.2021.1952920>

Scott, A. D. (1952). Federal Grants and Resource Allocation. *Journal of Political Economy*. <https://doi.org/10.1086/257313>

Smits, J., & Permanyer, I. (2019). The Subnational Human Development Database. *Scientific Data*, 6(1), Article 1. <https://doi.org/10.1038/sdata.2019.38>

Tandon, A., & Cashin, C. (2010). Assessing public expenditure on health from a fiscal space perspective. World Bank. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail>

Tandon, A., Fleisher, L., Li, R., & Yap, W. (2014). Reprioritizing government spending on health: Pushing an elephant up the stairs? *WHO South-East Asia Journal of Public Health*, 3(3), 206. <https://doi.org/10.4103/2224-3151.206742>

Taylor, F., & Dessai, S. P. S. (2023). Relation Between Per Capita Public Expenditure on Health and Income in India at Sub-National Level. *Indian Journal of Public Administration*, 00195561221149914. <https://doi.org/10.1177/00195561221149914>

UNDP (1991). *Human Development Report 1991: Financing Human Development*. Oxford University Press.

UNDP. (2013). *Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World*. United Nations Development Programm.

Youth in India-2022. (2022). National Statistical Office, Ministry of Statistics and Programme Implementation, Government of India. https://mospi.gov.in/sites/default/files/publication_reports/Youth_in_India_2022.pdf

Annexure 1

Model Specification of PMG estimates

Adopting Pesaran et al., (1999) PMG model,

$$y_{it} = \sum_{j=1}^p \lambda_{it} y_{it-j} + \sum_{j=0}^q \beta_{it} x_{it-j} + \mu_i + \varepsilon_{it} \quad (A1)$$

where $t=1,2,3,\dots,T$ and $i=1,2,3,\dots,N$, thus adopting this equation, our panel ARDL equation is

Panel ARDL model for health is represented as-

$$\begin{aligned} ghe_{it} = & \sum_{j=1}^p \beta_0 ghe_{it-j} + \sum_{j=0}^q \beta_1 otr_{it} + \sum_{j=0}^q \beta_2 ntr_{it} + \sum_{j=0}^q \beta_3 grants_{it} \\ & + \sum_{j=0}^q \beta_4 tax\ transfers_{it} + \sum_{j=0}^q \beta_5 fd_{it-j} + \sum_{j=0}^q \beta_6 HDI_{it-j} \\ & + \sum_{j=0}^q \beta_7 doc1000_{it} + \sum_{j=0}^q \beta_8 population_{it} + \mu_i + \varepsilon_{it} \end{aligned} \quad (A2)$$

Reparametrising this ARDL model, the corresponding Vector Error Correction Model (VECM) is obtained as VECM equation.

$$\begin{aligned} \Delta ghe_{it} = & \phi_i (ghe_{it-1} + \beta_1^1 fd_{it} + \beta_2^1 HDI_{it}) + \sum_{j=1}^{p-1} \lambda_{ij}^* \Delta ghe_{it-j} + \sum_{j=1}^{q-1} (\delta_{1ij}^* \Delta otr_{it-j} \\ & + \delta_{2ij}^* \Delta ntr_{it-j} + \delta_{3ij}^* \Delta grants_{it-j} + \delta_{4ij}^* \Delta tax\ transfers_{it-j} \\ & + \delta_{5ij}^* \Delta fd_{it-j} + \delta_{6ij}^* \Delta HDI_{it-j} + \delta_{7ij}^* \Delta doc1000_{it-j} \\ & + \delta_{8ij}^* \Delta population_{it-j}) + \mu_i + \varepsilon_{it} \end{aligned} \quad (A3)$$

Here $i=1,2,3,\dots,N$ and $t=1,2,3,\dots,T$.

β_1^1 and β_2^1 are long run coefficients

δ_{1ij} to δ_{7ij} is the short run coefficients

ϕ_i is the speed of adjustment of the parameter

μ_i refer to the fixed effect coefficient

Here $i=1,2,3,\dots,N$ and $t=1,2,3,\dots,T$.

It represents the health expenditure on various explanatory variables for the panel of 15 states for the period of 1991 to 2021.

Annexure 2

Panel Unit root, Cross-sectional Dependence and Cointegration test

The initial step is to estimate the stationarity

of the dataset in the model. Here we use panel unit root process accounting for individual effect. Levin, Lin & Chu test and Im, Pesaran and Shin statistics is used to check for stationarity of the data set. We find that all variables exhibit I(1) stationary (Table A-1).

Table A-1: Panel Unit root test results

Variable	Level		First Difference	
	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat
GHE	9.337	11.650	-3.427***	-5.629***
GFD	-2.253**	-1.294*	-11.574***	-13.176***
SOTR	5.101	9.090	-3.628***	-6.518***
SNTR	2.558	0.337	-4.007***	-10.366***
GRANTS	4.777	6.856	-10.494***	-13.292***
TAX TRANSFERS	10.008	12.571	-10.366***	-12.558***
HDI	2.589	7.809	-2.109**	-4.285***
DOCTORPER1000	14.002	11.001	5.206	-3.631***
POPULATION	-4.846***	2.121	-5.958***	-6.377***

Source: Authors' own calculation.

***, ** and * denote the significance at the 1%, 5% and 10% level, respectively.

Then the cross-sectional dependence among the variables is conducted through Breusch-Pagan LM (1980) test and Pesaran CD (2004) test to check for heterogeneity in the panel. Here the null

hypothesis is no cross-sectional relationship. The results from Table A-2 indicated the rejection of null hypotheses and established that heterogeneity among the panel exists.

Table A-2: Cross-Sectional Dependence

Cross- Sectional Dependence	Breusch-Pagan LM	Pesaran CD
GHE	2681.561***	51.546***
GFD	1128.786***	31.903***
SOTR	2735.880***	52.145***
SNTR	544.165***	12.571***
GRANTS	2483.290***	49.769***
TAX TRANSFERS	2857.135***	53.414***
HDI	3011.828***	v
DOCTORPER1000	2785.938***	52.731***
POPULATION	2644.240***	40.378***

Source: Authors' own calculation.

***statistical significance at 1% level.

The next step is to check for cointegration among the lagged dependent and independent variables. Pedroni (1999, 2004) test for

cointegration is used to check for cointegration. It presents both within and between dimensions accounting for panel heterogeneity.

Table A-3: Pedroni cointegration test Results

	Health
Panel v-Statistic	-0.053
Panel rho-Statistic	-10.911 ***
Panel PP-Statistic	-13.06 ***
Panel ADF-Statistic	-4.828 ***
Group rho-Statistic	-9.695 ***
Group PP-Statistic	-14.91 ***
Group ADF-Statistic	-3.967 ***

Source: Authors' own calculation.

***statistical significance at 1% level.

Thus, the results in Table A-3 of the cointegration test establish that there is a cointegrating relationship between the government health expenditure and fiscal deficit and also HDI which

establishes a long-run relation exists. The panel cointegration relationship establishes the potential causal relationship.

Impact of Financial Inclusion on India's Regional Economic Growth : Evidence from Rajasthan

Aashi Jain¹ and C.R. Bishnoi²

Abstract

This paper constructs a multidimensional Financial Inclusion Index (FII) as well as Financial Inclusion Dimension Indices and estimates the impact of financial inclusion on economic growth in Rajasthan using data from 1994 to 2021. Techniques of estimation include the linear Autoregressive Distributed Lag (ARDL) and Non-Linear Autoregressive Distributed Lag (NARDL) bounds co-integration technique taking real gross state domestic product per capita (a proxy for economic growth) as a dependent variable, three Financial Inclusion Dimension Indices (penetration, availability and usage) as independent variables and four control variables (government expenditure, gross fixed capital formation, population and inflation rate). Results show that Financial Inclusion Dimension Indices as well as two control variables-gross fixed capital formation and government expenditure have positive impact on growth rate but two other control variables- inflation rate and population have negative impact on growth rate in the long run in Rajasthan. From the NARDL model, it is evident that the coefficients of Financial Inclusion Dimension Indices are asymmetric, indicating that positive and negative changes in the Financial Inclusion Dimension Indices affect the economic growth differently. Both ARDL and NARDL models are free from problems of autocorrelation and heteroskedasticity and residuals are normally distributed and CUSUM and CUSUM of squares tests demonstrate that the model is stable, with correctly estimated parameters. Therefore, results of model are robust and reliable.

JEL Classification Codes: O43, G21, O40, R15, R1

1. Introduction

The Reserve Bank of India (RBI) shifted its emphasis in 2005 from providing only loans to the underprivileged sections of society to providing all types of financial services to them. This is the time, when the term “Financial Inclusion” appeared for the first time in India. Dr. Y. V. Reddy, who was the RBI Governor at that time, formally introduced the term “Financial Inclusion” in the RBI Annual Policy Statement for the year 2005–2006. Dr. Reddy emphasized the importance of aligning banking procedures with investment objectives that encompassed every section of society. The key components of this strategy included connecting individuals through

the financial system rather than solely focusing on providing credit. This shift signified a broader approach towards financial inclusion, aiming to provide a range of financial services beyond just loans to the underserved and marginalized section of society.

The concept of financial inclusion is multifaceted, with varying perspectives across countries. Its primary goal is to enhance the standard of living of every individual by providing them with access to affordable financial services. This is essential for economic development as it facilitates both the expansion of financial industry and equitable distribution of low-cost financial services across all segments of society. Financial

¹ Research Scholar, Department of Economics, IIS (Deemed to be University), Jaipur, Rajasthan, India-302020. E-mail: aashijain31743@iisuniv.ac.in

² Professor, Department of Economics, IIS (Deemed to be University), Jaipur, Rajasthan, India-302020. E-mail: crbishnoi@gmail.com

inclusion entails a process, often facilitated by institutional players, to integrate unbanked individuals into the formal banking system, thereby playing a crucial role in fostering both financial development and overall economic progress (Sharma, 2016).

According to RBI, “Financial inclusion is the process of ensuring access to appropriate financial products and services needed by vulnerable groups such as weaker sections and low-income groups at an affordable cost in a fair and transparent manner by mainstream institutional players.” According to CRISIL (2013), the term financial inclusion refers to the extent to which all segments of society have access to formal financial services such as loans, deposits, insurance, and pension services.

The existing body of financial literature affirms the positive impact of broadening financial inclusion, leading to increased economic growth and reduced poverty rates across numerous countries. Studies conducted by Schumpeter (1911), Goldsmith (1969), McKinnon (1973), Patrick (1966), and Levine (1997) have underscored a favourable effect of financial development on economic growth. Various studies about financial inclusion and economic growth have employed cross-sectional and panel data, as evidenced by De Gregorio and Guidotti (1995), King and Levine (1993), Rajan and Zingales (1996) and Khan and Senhadji (2000).

Several studies have demonstrated that finance inclusion not only fosters financial stability but also contributes to long-term economic growth (Sharma, 2016; Dahiya and Kumar, 2020). Financial inclusion can also reduce debt, facilitate convenient spending, protect investment, and mitigate financial risk experienced by unbanked and underbanked individuals (Sahay et al., 2015; Corrado and Corrado, 2017; Yah and Chamberlain, 2018). Consequently, financial inclusivity fosters overall economic advancement, narrows income

disparities, and ensures poverty eradication (Adedokun and Aka, 2021; Honohan, 2004). This is the reason that financial inclusion has been included as a key target among the Sustainable Development Goals (SDGs) outlined by the United Nations (UN), encompassing eight out of the 17 goals (Abor et al., 2018).

Furthermore, another body of research has observed that either there is no impact or negative impact of financial inclusion on economic growth. Studies by Singh (1997), Narayan and Narayan (2013), and Grassa and Gazdar (2014) have indicated a lack of significant positive impact of financial inclusion on economic growth.

However, majority of studies above on financial inclusion have been conducted at macro-level and some studies are carried out for cross-country analysis using secondary data. Though a few studies have been carried at regional level in India, but no study is available for the state of Rajasthan. The main purpose of this paper is to fill in this research gap with focus on the following. Firstly, we construct overall as well as dimension FII for Rajasthan considering six diverse financial inclusion indicators covering three dimensions (availability, penetration and usage). Secondly, we examine the impact of these three dimensions of financial inclusion on economic growth of Rajasthan with help of ARDL model. Thirdly, we use not only linear ARDL model but also NARDL model to test whether there is symmetric relationship between three dimensions of financial inclusion and economic growth or asymmetrical relationship.

Rest of this paper is organised as follows. Section 2 outlines the model specification, data and methodology used, Sections 3 presents and discusses the empirical findings, and Section 4 concludes the study and discusses its policy implications.

2. Methodology

2.1. Model Specification

Following model is used to estimate the impact of financial inclusion on economic growth of Rajasthan:

$$\ln RGSDPPC_t = \beta_0 + \beta_1 \ln PNT_t + \beta_2 \ln AVL_t + \beta_3 \ln USG_t + \beta_4 \ln GE_t + \beta_5 \ln GFCF_t + \beta_6 \ln POP_t + \beta_7 \ln INF_t + \varepsilon_t \quad (1)$$

Here, RGSDPPC is dependent variable, representing real gross state domestic product per capita (acting as a proxy for economic growth), and PNT, AVL and USG are penetration, availability and usage dimension of financial inclusion, respectively, are independent variables. Additionally, four control variables are incorporated based on data availability: GE (government expenditure), GFCF (gross fixed capital formation), POP (population) and INF (rate of inflation). Inflation is an indicator of macroeconomic stability as it impacts purchasing power, investment, interest rates, and overall economic stability. All the variables used are converted into natural logarithms to get the values of elasticities directly.

2.2. Data Sources

Data used in the study is sourced from the Directorate of Economics and Statistics (DES), Rajasthan, the Economic and Political Weekly Research Foundation (EPWRF), and the Reserve Bank of India (RBI). The study period spans from 1994 to 2021.

2.3. Construction of Financial Inclusion Index

The study employs a multidimensional measure of financial inclusion, denoted as FII. The construction of FII follows the methodology given by Sarma (2008). The FII is computed by initially calculating a dimension index for each aspect of financial inclusion. Our study incorporates the following three dimensions:

- Availability of Banking Services
- Banking Penetration
- Usage of Banking System

For construction of these three dimensions, we use six diverse financial inclusion indicators. Availability of banking services is measured by number of bank branches per million population. Proxies for penetration of banking services include number of deposit accounts per 1000 population and number of credit accounts per 1000 population. For usage of banking services, per capita deposit, per capita credit, and the credit-to-deposit ratio are utilized in the construction process.

Dimension index for Rajasthan is calculated by using the following formula.

$$di = \frac{Ai - mi}{Mi - mi} \quad (2)$$

Here, Ai= actual value of dimension i, mi= minimum value of dimension i, Mi= maximum value of dimension i and di= dimension index of financial inclusion.

Equation (2) guarantees that $0 \leq di \leq 1$ is true. The value of di is a measure of how well the particular region has performed in dimension i. A region i will be represented as a point $Di = (d1, d2, d3, \dots, dn)$ on the n-dimensional Cartesian space if n dimensions of financial inclusion are taken into account.

In n-dimensional space, the point $O = (0,0,0, \dots, 0)$ denotes the worst-case scenario, whereas the point $I = (1,1,1, \dots, 1)$ denotes the best performance across all dimensions. The normalized inverse Euclidean distance of a point Di from an ideal point $I = (1,1,1, \dots, 1)$ is then used to calculate the index of financial inclusion, or FII, for the i-th region as given below.

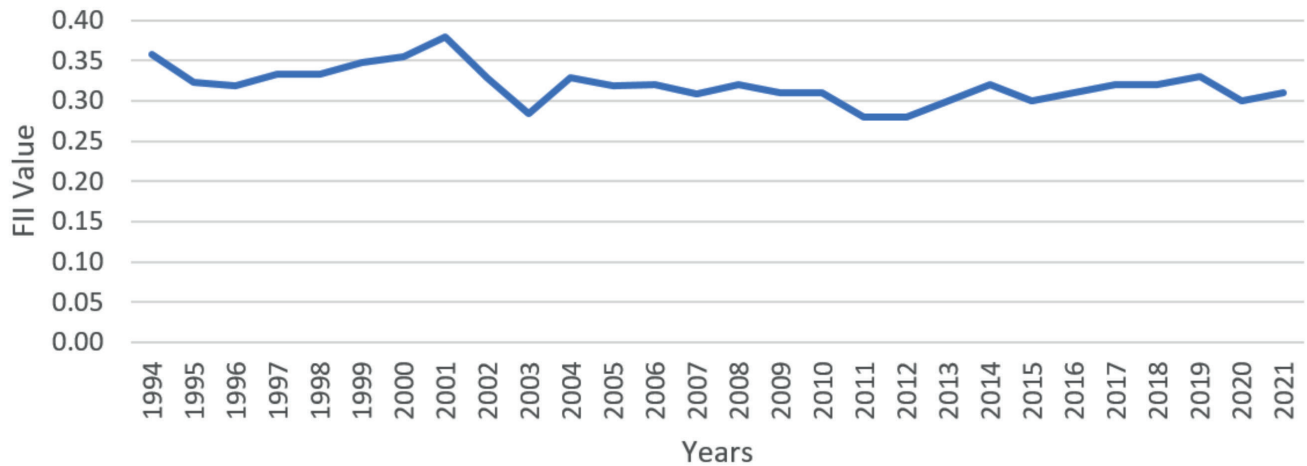
$$IFI_i = 1 - \frac{\sqrt{(1-d_1)^2 + (1-d_2)^2 + \dots + (1-d_n)^2}}{\sqrt{n}} \quad (3)$$

In equation (3), inverse normalized distance is obtained by normalizing the Euclidean distance of D_i from an ideal point 1 by n and subtracting it from 1. For this reason, for a higher value of FII to indicate greater financial inclusion, the value

is normalized to range between 0 and 1 and the inverse distance is taken into account.

The FII for Rajasthan, so calculated, is depicted in **Figure 1**.

Figure 1: Financial Inclusion Index for Rajasthan



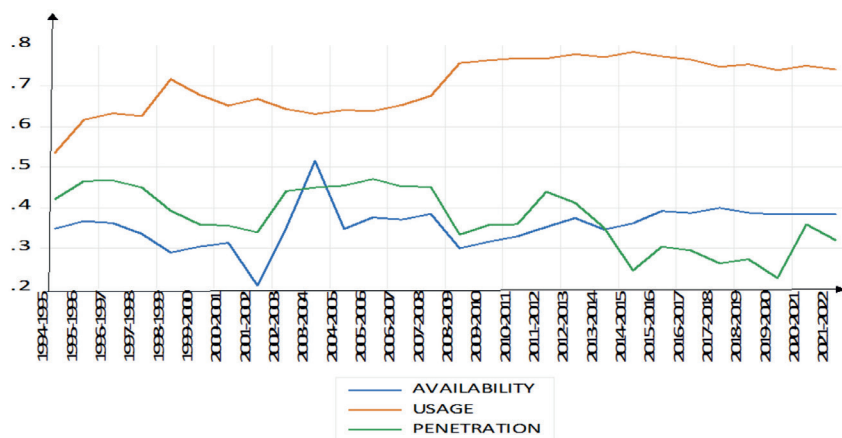
Source: Constructed by Authors.

It is evident from Figure 1 that the computed value of FII for Rajasthan has remained stagnant over the years. The lowest level of inclusion was in 2012 with an FII value of 0.280 and the highest level was observed in 2001 with an FII value of 0.380. Throughout the selected period, the state has consistently experienced a low to medium

levels of financial inclusion with FII values varying below 0.40.

In addition, **Figure 2** shows the distinct source, patterns and shifts observed in each dimension provide critical insights into the dynamics influencing FII over the years.

Figure 2: Trends in Availability, Usage and Penetration from 1994 to 2021



Source: Constructed by Authors.

Overall, the availability metric shows consistent long-term growth, while usage and penetration exhibit volatility, marked by a significant peak around 2010-2011 followed by a decline and subsequent stabilization. These patterns suggest that while accessibility dimension has steadily improved, actual utilization and market penetration are influenced by more dynamic and short-term factors.

Furthermore, a comparative analysis between India and Rajasthan across six key indicators is conducted to examine the factors influencing the FII, emphasizing regional differences and providing valuable insights into the dynamics of accessibility, utilization, and market penetration over the time period. Comparison of 6 indicators of FII between India and Rajasthan is shown in **Figure 3**.

Figure 3: Comparison of 6 Indicators of FII between India and Rajasthan



Source: Constructed by Authors.

Figure 3 reveals notable disparities in the financial inclusion parameters of India and Rajasthan. Both India and Rajasthan show a decline in bank branches per million population, with Rajasthan consistently having fewer branches, indicating less banking infrastructure. India surpasses Rajasthan in deposit accounts per 1000 population, though both exhibit initial declines and fluctuations. Interestingly, Rajasthan has more credit accounts per 1000 population than India, marked by significant fluctuations and a notable increase around 1997. Per capita deposits and credits are increasing in both India and Rajasthan, but India's figures remain significantly higher, highlighting a disparity in savings and borrowing capacities. The credit-deposit ratio trends similarly for both, yet Rajasthan generally maintains a slightly lower ratio, reflecting a conservative lending environment or lower credit demand.

Overall, Rajasthan lags behind the national average in most financial inclusion indicators, underscoring the need for enhanced banking infrastructure, increased financial penetration and policies to promote credit growth to bridge this gap.

2.4. Estimation of Impact of FII on Economic Growth

2.4.1. Linear ARDL Cointegration Test

Before proceeding with the estimation of time-series model (1), the orders of integration of all series is tested by Im, Pesaran, and Shin (IPS) test. The IPS test offers several benefits, including robustness, efficiency, applicability to various data structures, versatility, and a strong theoretical basis, making it a valuable tool for identifying the order of integration of time series data in economic analysis. The ARDL (Autoregressive Distributed Lag)-bound testing approach provided by Pesaran et al. (2001) could be used if variables are I (0), I (1), or mixtures of both, but none of variables is I (2) (Pesaran and Pesaran, 1997). The

ARDL model uses lagged values of the dependent and independent variables as regressors. An additional notable feature of ARDL approach is that it provides accurate t values for unbiased long run estimations even when some of the regressors are endogenous (Owusu and Odhiambo, 2014). Furthermore, it delineates the short- and long-term impact of each variable separately. Consequently, the ARDL model captures more information than the co-integration technique proposed by Johansen and Julius (Pesaran and Shin, 1999). The dynamic ARDL model is described as follows:

$$\begin{aligned} \Delta \ln \text{RGSDPPC}_t = & \alpha_0 + \lambda_1 \ln \text{RGSDPPC}_{t-1} + \lambda_2 \ln \text{PNT}_{t-1} + \lambda_3 \ln \text{AVL}_{t-1} + \lambda_4 \ln \text{USG}_{t-1} + \\ & \lambda_5 \ln \text{GE}_{t-1} + \lambda_6 \ln \text{GFCF}_{t-1} + \lambda_7 \ln \text{POP}_{t-1} + \lambda_8 \ln \text{INFRATE}_{t-1} + \\ & \sum_{i=1}^{p-1} \gamma_i \Delta \ln \text{RGSDPPC}_{t-i} + \sum_{j=0}^{q_1-1} \beta_{1j} \Delta \ln \text{PNT}_{t-j} + \sum_{j=0}^{q_2-1} \beta_{2j} \Delta \ln \text{AVL}_{t-j} + \\ & \sum_{j=0}^{q_3-1} \beta_{3j} \Delta \ln \text{USG}_{t-j} + \sum_{j=0}^{q_4-1} \beta_{4j} \Delta \ln \text{GE}_{t-j} + \sum_{j=0}^{q_5-1} \beta_{5j} \Delta \ln \text{GFCF}_{t-j} + \\ & \sum_{j=0}^{q_6-1} \beta_{6j} \Delta \ln \text{POP}_{t-j} + \sum_{j=0}^{q_7-1} \beta_{7j} \Delta \ln \text{INFRATE}_{t-j} + e_t \end{aligned} \quad (4)$$

Where α_0 is the intercept term, e_t is white noise error term, Δ is the first difference operator, and the remaining variables are as defined earlier. In this model, the long-term multipliers are λ 's. Testing for a long-term relationship between variables using the F-test is the initial step in the ARDL bound test technique (Pesaran et al., 2001). The null hypothesis for the long-term relationship between variables in the ARDL framework is:

$$H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = \lambda_7 = \lambda_8 = 0 \quad (5)$$

which indicates that there is no cointegration or long-term relationship between the variables. The alternative hypothesis is the existence of co-integration or long-run relationship between the variables. The lower bound and upper bound critical values for the F-test are provided by Pesaran et al. (2001). If the computed F-statistic is higher than the upper bound critical value, the null hypothesis is rejected. Conversely, if the F-statistic is smaller than the lower bound critical

value the null hypothesis is not rejected. However, the test becomes inconclusive if the F-statistic falls between the critical values of I (0) and I (1).

The Error Correction Model (ECM) is derived from the ARDL model and in which the Error Correction Term (ECT) examines the short-run association of variables without omitting any long-run information. It can be used to determine causality after the variables have been co-integrated. The ECM model utilized in our analysis is presented below:

$$\begin{aligned} \Delta \ln \text{RGSDPPC}_t = & \alpha_0 + \sum_{i=1}^{p-1} r_i \Delta \ln \text{RGSDPPC}_{t-i} + \sum_{j=0}^{q_1-1} \beta_{1j} \Delta \ln \text{PNT} + \\ & \sum_{j=0}^{q_2-1} \beta_{2j} \Delta \ln \text{AVL}_{t-j} + \sum_{j=0}^{q_3-1} \beta_{3j} \Delta \ln \text{USG}_{t-j} + \sum_{j=0}^{q_4-1} \beta_{4j} \Delta \ln \text{GE}_{t-j} + \\ & \sum_{j=0}^{q_5-1} \beta_{5j} \Delta \ln \text{GFCE}_{t-j} + \sum_{j=0}^{q_6-1} \beta_{6j} \Delta \ln \text{POP}_{t-j} + \\ & \sum_{j=0}^{q_7-1} \beta_{7j} \Delta \ln \text{INFRATE}_{t-j} + \delta \text{ECT}_{t-1} + e_t \end{aligned} \quad (6)$$

Here, the coefficient of the ECT, denoted by δ , represents the speed at which long-term equilibrium is reestablished following a long-term shock. For stability of equilibrium the value of δ should be negative and significant. The significance of the F-statistic using the Wald-test indicates the outcome of short-run causality.

2.4.2. Nonlinear ARDL Cointegration Test

In order to test the asymmetric effects of FII dimensions, nonlinear ARDL developed by Shin et al. (2014) is employed which initially separates the increasing FII dimensions from the declining FII dimensions and denotes them by PNT+, AVL+, USG+ and PNT-, AVL-, USG- respectively. These are defined as a partial sum of negative and positive changes.

The dynamic NARDL model may be described as follows:

$$\begin{aligned} \Delta \ln \text{RGSDPPC}_t = & \alpha_0 + \lambda_1 \ln \text{RGSDPPC}_{t-1} + \lambda_2 \ln \text{PNT}^+_{t-1} + \lambda_3 \ln \text{PNT}^-_{t-1} + \\ & \lambda_4 \ln \text{AVL}^+_{t-1} + \lambda_5 \ln \text{AVL}^-_{t-1} + \lambda_6 \ln \text{USG}^+_{t-1} + \lambda_7 \ln \text{USG}^-_{t-1} + \\ & \lambda_8 \ln \text{GE}_{t-1} + \lambda_9 \ln \text{GFCE}_{t-1} + \lambda_{10} \ln \text{POP}_{t-1} + \lambda_{11} \ln \text{INFRATE}_{t-1} + \\ & \sum_{i=1}^{p-1} r_i \Delta \ln \text{RGSDPPC}_{t-i} + \sum_{j=0}^{q_1-1} \beta_{1j} \Delta \ln \text{PNT}^+_{t-j} + \\ & \sum_{j=0}^{q_2-1} \beta_{2j} \Delta \ln \text{PNT}^-_{t-j} + \sum_{j=0}^{q_3-1} \beta_{3j} \Delta \ln \text{AVL}^+_{t-j} + \\ & \sum_{j=0}^{q_4-1} \beta_{4j} \Delta \ln \text{AVL}^-_{t-j} + \sum_{j=0}^{q_5-1} \beta_{5j} \Delta \ln \text{USG}^+_{t-j} + \\ & \sum_{j=0}^{q_6-1} \beta_{6j} \Delta \ln \text{USG}^-_{t-j} + \sum_{j=0}^{q_7-1} \beta_{7j} \Delta \ln \text{GE}_{t-j} + \\ & \sum_{j=0}^{q_8-1} \beta_{8j} \Delta \ln \text{GFCE}_{t-j} + \sum_{j=0}^{q_9-1} \beta_{9j} \Delta \ln \text{POP}_{t-j} + \\ & \sum_{i=0}^{q_{10}-1} \beta_{10i} \Delta \ln \text{INFRATE}_{t-i} + e_t \end{aligned} \quad (7)$$

As per this specification, the parameters representing the impact of positive shocks of FII dimensions on RGSDPPC are denoted by λ_2 , λ_4 and λ_6 , and λ_3 , λ_5 and λ_7 capture the influence of negative shocks of FII dimensions on RGSDPPC. Additionally, Pesaran et al. (2001) and Shin et al. (2011) proposed the derivation of the error correction term as follows:

$$\begin{aligned} \Delta \ln \text{RGSDPPC}_t = & \alpha_0 + \sum_{i=1}^{p-1} r_i \Delta \ln \text{RGSDPPC}_{t-i} + \sum_{j=0}^{q_1-1} \beta_{1j} \Delta \ln \text{PNT}^+_{t-j} + \\ & \sum_{j=0}^{q_2-1} \beta_{2j} \Delta \ln \text{PNT}^-_{t-j} + \sum_{j=0}^{q_3-1} \beta_{3j} \Delta \ln \text{AVL}^+_{t-j} + \\ & \sum_{j=0}^{q_4-1} \beta_{4j} \Delta \ln \text{AVL}^-_{t-j} + \sum_{j=0}^{q_5-1} \beta_{5j} \Delta \ln \text{USG}^+_{t-j} + \\ & \sum_{j=0}^{q_6-1} \beta_{6j} \Delta \ln \text{USG}^-_{t-j} + \sum_{j=0}^{q_7-1} \beta_{7j} \Delta \ln \text{GE}_{t-j} + \\ & \sum_{j=0}^{q_8-1} \beta_{8j} \Delta \ln \text{GFCE}_{t-j} + \sum_{j=0}^{q_9-1} \beta_{9j} \Delta \ln \text{POP}_{t-j} + \\ & \sum_{j=0}^{q_{10}-1} \beta_{10j} \Delta \ln \text{INFRATE}_{t-j} + \delta \text{ECT}_{t-1} + e_t \end{aligned} \quad (8)$$

3. Data Analysis and Results

3.1. Pre-Model Estimation Tests

Before discussing the empirical results of model, the study presents the descriptive statistics and correlation matrix in Table A-1 of Annexure-1. The upper part of Table A-1 shows that all the variables, except LNAVL are normally distributed according to the Jarque-Bera test for normality. The lower part of the table shows that growth rate (RGSDPPC) is positively related to all variables except LNPNT.

To check the unit roots of data, we performed the Im, Pesaran, and Shin (IPS) test with intercept and trend. Table A-2 of Annexure-1 displays the results of the unit root test. The results show that

variables are integrated of mixed order, but none of variables is I(2). So, the ARDL and non-linear ARDL models are appropriate. The optimum lag length for the variables must be known before estimating the ARDL and NARDL models. Table A-3 of Annexure-1 shows the outcomes of the lag order selection criterion, which indicate that the maximum lag length of 1 is appropriate for the estimation of ARDL and NARDL models.

3.2. Bounds Test

The bounds test is used to examine the presence

of a long-run relationship between Rajasthan's real GSDP per capita and FII dimensions with the help of the ARDL and NARDL models. For the ARDL estimator, the Pesaran et al. (2001) bounds test was employed, incorporating the approximate probability values and critical values provided by Kripfganz and Schneider (2020) and the NARDL estimator utilized the methodology proposed by Shin et al. (2014). Results of bounds test are given in **Table 1**.

Table 1: Bounds test results

Model Specification	F-statistics	Lower bound	Upper bound	Conclusion
Linear	8.747036	2.5	3.5	Co-integration
Non-linear	77.225694	1.980	3.040	Co-integration

Source: Estimated by Authors.

Note: The critical values utilized in the analysis were sourced from Narayan (2005) and applied at a significance level of 5%.

The results of Table 1 indicate that the linear ARDL model yielded an F-statistic of 8.75, which is more than the upper bound critical values at a 5 per cent level of significance. Likewise, the non-linear ARDL bound test shows an F-statistic of 77.23, which is more than the critical value at a 5 per cent level of significance. As a result, the null hypothesis of no cointegration is rejected. This suggests that the variables under investigation exhibit both symmetric and asymmetric

cointegration. Consequently, both models confirm the presence of long-run relationship among the variables. Thus, ARDL and NARDL models are estimated below.

3.3. Long-run Coefficients and Error Correction Term from ARDL & NARDL model

Table 2 shows the outcome of the estimated ARDL model.

Table 2: Long-run coefficients and error correction term of ARDL model

	Coefficient	Probability
Long run		
LPNT	0.117228 (0.067)	0.1093
LAVL	0.048985 (0.056)	0.4045
LUSG	0.520648* (0.239)	0.0505
LGE	0.212868*** (0.086)	0.0293
LGFCF	0.339853*** (0.092)	0.0031
LPOP	-1.548756*** (0.731)	0.0057
LINF	- 0.486365* (0.270)	0.0970
C	0.037517 (0.023)	0.1429

<i>Short run</i>		
D(LPNT)	0.020586 (0.031)	0.5232
D(LUSG)	0.346131*** (0.109)	0.0081
D(LGE)	0.139734** (0.051)	0.0181
D(LGFCF)	0.130039*** (0.057)	0.0420
D(LPOP)	5.871911*** (1.115)	0.0002
CointEq(-1)*	-0.654660*** (0.109)	0.0000

Source: Estimated by Authors.

Note: ***, **, and * show significance levels of 1%, 5%, and 10%, respectively. Standard errors are given within parentheses.

The results show that the all dimensions of FII have long run positive effect on economic growth of Rajasthan. The usage dimension has significant elasticity coefficient is at 10 per cent level of significance and that of penetration at 10.93 per cent level of significance. However, availability dimension has positive but insignificant effect on economic growth. Further, long run coefficients of LNGFCF and LNGE are positive and statistically significant and those of LNINF and LNPOP are negative and statistically significant at 10 per cent and 1 per cent level of significance. This implies that FII dimension indices as well as control variables GFCF and GE have a positive impact on growth rate but the control variable INF and POP have negative impact on growth rate in the long run in Rajasthan.

The short-term elasticity coefficients are observed to be positive and statistically significant except penetration dimension, which is positive but insignificant. This suggests that an increase in PNT does not have a significant immediate positive impact on growth levels in short run. The speed of adjustment parameter, also known as the feedback effect, is a negative and statistically significant term for error correction. This suggests a long-term convergence to equilibrium. Additionally, result shows that an annual adjustment of 65 per cent occurs, indicating quick adjustment.

The nonlinear model enables the assessment of both positive and negative shocks of FII dimensions on economic growth, as illustrated in **Table 3**.

Table 3: Long-run Coefficients and Error Correction Term of NARDL model

Variable	Coefficient	Probability
<i>Long run</i>		
LPNT+	-0.065422*** (0.022)	0.0101
LAVL+	0.259350*** (0.023)	0.0000
LAVL-	0.285390*** (0.041)	0.0000
LUSG+	-0.226154** (0.086)	0.0194
LUSG-	4.047203*** (0.283)	0.0000
LGE	-0.174677*** (0.036)	0.0002
LGFCF	0.066638** (0.028)	0.0315
LPOP	5.649365*** (0.487)	0.0000
LINF(-1)	-0.281826** (0.116)	0.0283
C	3.219559*** (0.420)	0.0000
<i>Short run</i>		
D(LPNT+)	-0.204549*** (0.012)	0.0000
D(LPNT-)	-0.076928*** (0.015)	0.0001

D(LAVL+)	0.302315*** (0.013)	0.0000
D(LAVL+)	0.039390*** (0.012)	0.0050
D(LUSG+)	-0.449742*** (0.052)	0.0000
D(LUSG+)	3.376784*** (0.109)	0.0000
D(LINF)	-0.075907** (0.030)	0.0247
CointEq(-1)*	-0.795070*** (0.036)	0.0000

Source: Estimated by Authors.

Note: In the context of the results presented, ***, **, and * signify significance levels of 1%, 5%, and 10%, respectively. Standard error is represented within parenthesis.

Table 3 indicates that the coefficient representing the impact of positive changes in PNT and USG on economic growth is negative and statistically significant. Conversely, the effect of negative changes in AVL and USG on economic growth is negative but statistically significant.

In the short run, the coefficient associated with positive changes in PNT and USG is negative and statistically significant. Additionally, the coefficient linked to negative changes in PNT and USG is positive and statistically significant. However, both the positive and negative changes in AVL in short run are positive and significant. The speed of adjustment required to steer the economy back to its equilibrium path is notable, reaching at least 79 per cent and exhibiting statistical significance.

3.4. Coefficient Symmetry Test

The coefficient symmetry test is a statistical method employed to assess whether the influence of independent variables on the dependent variable remains consistent or varies asymmetrically over time. This evaluation entails scrutinizing whether positive and negative changes in an explanatory variable exert distinct impacts on the dependent variable which is depicted in Table A-4 of Annexure-2. The results indicate that the coefficients are asymmetric, indicating that positive and negative changes in the FII affect the economic growth differently.

3.5. Model Diagnostic Tests

Moreover, model diagnostic tests are also performed to verify the model's robustness. The results of these tests are shown in Table A-5 of Annexure-2.

It illustrates an R^2 value of 0.99, indicating that the regressors are capable of explaining approximately 99 per cent of the observed changes in the dependent variable. Moreover, the absence of autocorrelation in the residuals is suggested by the serial correlation test, while the heteroscedasticity test indicates a consistent residual variance over time. Additionally, the Jarque-Bera and Ramsey tests confirm that the errors adhere to a normal distribution, affirming the robust specification of both the model.

3.6. Stability of Estimated Model

To ensure model stability, Cumulative Sum (CUSUM) and CUSUM of squares tests were conducted. The results demonstrate that the model is stable, with correctly estimated parameters, as the estimated model falls within the 5% significance level for both CUSUM and CUSUM of squares tests, as illustrated in Figures A-1 of Annexure-2. These Figures shows that the results are within the 5 per cent significance bounds throughout the sample period. This proves the stability of the calculated ARDL model's both short and long run coefficients.

4. Conclusion and implications

This study has analysed the impact of financial inclusion on economic growth in Rajasthan, employing both linear and nonlinear ARDL models to capture the complexity of this relationship. The results demonstrate that financial inclusion positively influences economic growth, with the usage dimension showing significant effects. However, the mere availability of financial services, without corresponding utilization, proves insufficient in driving substantial economic growth. The analysis also reveals asymmetric effects, indicating that positive and negative changes in financial inclusion dimensions affect economic growth differently.

The ARDL cointegration technique is employed to identify the long-run relationship between series with varying orders of integration. The reparametrized results reveal both the short-run dynamics and the long-run relationships of the variables under consideration. Unlike ARDL, the NARDL model is specifically designed to incorporate the potential asymmetric effects of positive and negative changes in explanatory variables on the dependent variable.

Additionally, the NARDL model is simple yet comprehensive, allowing for asymmetry to switch between the short-run and long-run or vice versa. Therefore, when data indicates asymmetric effects, NARDL is preferable, whereas ARDL is suitable for symmetric relationships. The choice between ARDL and NARDL can be informed by specification tests for asymmetry. Both models complement each other and are not directly comparable.

Policy implications suggest that to harness the full potential of financial inclusion, efforts must extend beyond improving access. Enhancing financial literacy, bolstering banking infrastructure and implementing inclusive financial policies are crucial steps. Additionally, addressing regional disparities and focusing on both supply and

demand factors can significantly enhance the efficacy of financial inclusion initiatives. This study provides a comprehensive framework for policymakers, offering insights into designing targeted interventions that foster sustainable and inclusive economic growth in Rajasthan.

References

- Abor, J. Y., Issahaku, M., Amidu, M. and Murinde, V. (2018). Financial inclusion and economic growth: What do we know? Centre for Global Finance working paper, London, 11.
- Adedokun, M. W. and Ağa, M. (2021). Financial inclusion: A pathway to economic growth in Sub-Saharan economies. *International Journal of Finance and Economics*, 1–17.
- Corrado, G. and Corrado, L. (2017). Inclusive finance for inclusive growth and development. *Current Opinion in Environmental Sustainability*, 24, 19–23.
- CRISIL Inclusix. (2013). India's first comprehensive financial inclusion index, Vol. 3.
- Dahiya, S. and Kumar, M. (2020). Linkage between financial inclusion and economic growth: An empirical study of the emerging Indian economy. *Vision*, 24(2), 184-193.
- De Gregorio, J. and Guidotti, P.E. (1995). Financial development and economic growth. *World development*, 23(3), 433-448.
- Goldsmith, R.W. (1969). *Financial structure and development*. New Haven, CT: Yale University Press.
- Grassa, R. and Gazdar, K. (2014). Financial development and economic growth in GCC countries: A comparative study between Islamic and conventional finance. *International Journal of Social Economics*, 41(6), 493-514.
- Honohan, P. (2004). *Financial development, growth and poverty: How close are the links?*

- World Bank, Policy Research Working Paper, 3203.
- Khan, M.S. and Senhadji, A.S. (2000). Financial development and economic growth: An Overview. IMF Working Paper No. 00/209.
- King, R.G. and Levine, R. (1993). Finance entrepreneurship and growth. *Journal of Monetary Economics*, 32(3), 513-542.
- Levine, R. (1997). Financial development and economic growth: views and agenda. *Journal of Economic Literature*, 35(2), 688-726.
- Kripfganz, S. and Schneider, D.C. (2020). Response surface regressors for critical value bounds and approximate p-values in equilibrium correction models, *Oxford Bulletin of Economics and Statistics*, 82(6), 1456-1481.
- McKinnon, R.I. (1973). Money and capital in economic development. Washington, DC: Brookings Institution
- Narayan, P.K. and Narayan, S. (2013). The short-run relationship between the financial system and economic growth: New evidence from regional panels. *International Review of Financial Analysis*, 29, 70-78.
- Owusu, E. L. and Odhiambo, N. M. (2014). Financial liberalization and economic growth in Nigeria: An ARDL-bounds testing approach. *Journal of Economic Policy Reform*, 17(2), 164-177.
- Patrick, H. (1966). Financial development and economic growth in underdeveloped countries. *Economic Development and Cultural Change*, 14(2), 74-189.
- Pesaran, M.H. and Pesaran, B. (1997). Working with Microfit 4.0: interactive econometric analysis. Oxford University Press, Oxford.
- Pesaran, M. H. and Shin, Y. (1999). An autoregressive distributed lag modeling approach to cointegration analysis. Cambridge University Press, 371-413.
- Pesaran, M. H., Shin, Y. and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-326.
- Rajan, R.G. and Zingales, L. (1996). Financial dependence and growth (No. w5758). National Bureau of Economic Research.
- Reserve Bank of India (2005), 'Annual Policy Statement for the year 2005-06', by Dr. Y. Venugopal Reddy, Governor, Reserve Bank of India.
- Sahay, R., Čihák, M., N' Diaye, P., Barajas, A., Mitra, S., Kyobe, A. and Yousefi, S. R. (2015). Financial inclusion: Can it meet multiple goals? IMF Staff Discussion Note, 15-17.
- Sarma, M. (2008). Index of Financial inclusion, Indian Council for Research on International Economic Relations, 215.
- Schumpeter, J.A. (1911). The theory of economic development. Cambridge, MA: Harvard University Press.
- Sharma, D. (2016). Nexus between financial inclusion and economic growth: Evidence from the emerging Indian economy. *Journal of financial economic policy*, 8(1), 13-36.
- Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. *Festschrift in honor of Peter Schmidt: Econometric methods and applications*, 281-314.
- Singh, A. (1997). Financial liberalization, stock markets and economic development. *The Economic Journal*, 107(442), 771-782.
- Yah, N. C. and Chamberlain, M. N. E. (2018). Determinants of inclusive financial development in Africa. *Journal of Economics and Development Studies*, 6(3), 36-46.

Annexure 1 : Pre-Model Estimation Tests
Table A-1 : Descriptive Statistics and Correlation Matrix

	LNRGSDPPC	LNPNT	LNAVL	LNUSG	LNGE	LNGFCF	LNPOP	LNINF
Mean	10.84351	-1.000964	-1.043514	-0.357522	10.74174	11.32703	1.852719	4.326768
Median	10.79349	-1.024483	-1.016731	-0.317392	10.60359	11.31708	1.866187	4.259062
Maximum	11.42811	-0.753763	-0.662379	-0.243048	12.51128	12.75663	2.076813	5.105103
Minimum	10.29519	-1.485664	-1.569257	-0.623050	9.038484	9.988372	1.569428	3.559552
Std. Dev.	0.378365	0.212161	0.152791	0.098506	1.079097	0.913093	0.153831	0.485181
Skewness	0.117538	-0.652049	-1.057842	-0.681771	0.164194	0.057871	-0.262096	0.112362
Kurtosis	1.527268	2.445252	7.140605	2.744746	1.707978	1.456797	1.903266	1.584350
Jarque-Bera	2.594901	2.343151	25.22418	2.245135	2.073355	2.794016	1.723871	2.396995
Probability	0.273227	0.309878	0.000003	0.325443	0.354631	0.247336	0.422344	0.301647
Observations	28	28	28	28	28	28	28	28
Correlation Matrix								
LNRGSDPPC	1.000000							
LNPNT	-0.720641	1.000000						
LNAVL	0.363733	0.011924	1.000000					
LNUSG	0.827570	-0.633581	0.028732	1.000000				
LNGE	0.988302	-0.721430	0.380386	0.800479	1.000000			
LNGFCF	0.992846	-0.692176	0.360664	0.835003	0.985652	1.000000		
LNPOP	0.970523	-0.663936	0.344084	0.821151	0.982831	0.976351	1.000000	
LNINF	0.991244	-0.708535	0.341861	0.837244	0.992609	0.995226	0.981381	1.000000

Source : Estimated by Authors.

Table A-2 : Results of Stationarity tests

Variable	At Level		At First Difference	
	t-Stat	Prob.	t-Stat	Prob.
LNRGSDPPC	-2.6224	0.2740	-8.3552	0.0000***
LNPNT	-3.1125	0.1236	-6.2744	0.0001***
LNAVL	-4.0532	0.0188**	-6.2611	0.0001***
LNUSG	-2.8841	0.1827	-6.0136	0.0002***
LNGE	-2.0418	0.5532	-5.6510	0.0005***
LNGFCF	-1.5866	0.7716	-4.2021	0.0140**
LNPOP	-1.3208	0.8607	-4.7880	0.0038***
LNINF	-2.7142	0.2396	-4.2400	0.0129**

Source: Estimated by Authors.

Note: ** indicates the test statistics is significant at 5% level of significance.

*** indicates the test statistics is significant at 1% level of significance.

Table A-3 : VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	232.1632	NA	8.49e-18	-16.60468	-16.22073	-16.49051
1	449.1731	289.3465*	1.25e-22*	-27.93875*	-24.48318*	-26.91123*

Source: Estimated by Authors.

* Indicates lag order selected by the criterion.

LR: sequential modified LR test statistic (each test at 5% level).

FPE: Final prediction error.

AIC: Akaike information criterion.

SC: Schwarz information criterion.

HQ: Hannan-Quinn information criterion.

Annexure 2 : Coefficient Symmetry and Model Diagnostic Tests

Table A-4 : Results of Coefficient Symmetry Test

Variable	F value	Probability
Long run		
LAVL	0.609544	0.4605
LPNT	41.24944	0.0004
LUSG	143.1783	0.0000
Short run		
LAVL	10.22799	0.0151
LPNT	3.240016	0.1149
LUSG	51.43918	0.0002
Joint (Long run and short run)		
LAVL	9.062752	0.0114
LPNT	23.39185	0.0008
LUSG	75.13222	0.0000

Source: Estimated by Authors.

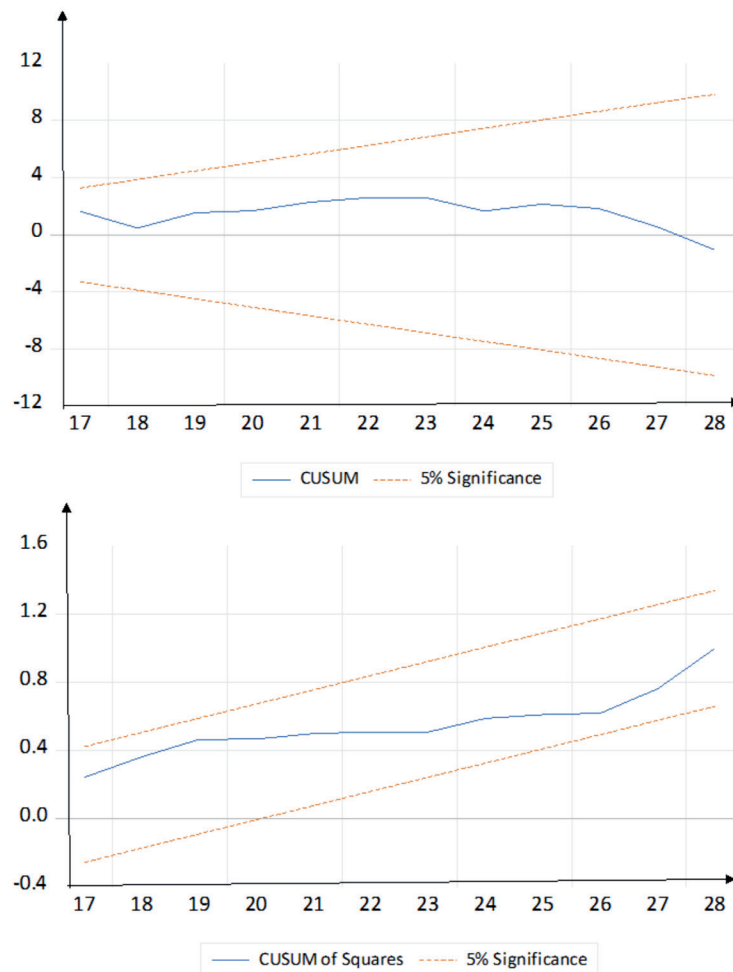
Table A-5: Results of Model Diagnostic Tests

	ARDL	NARDL
R^2	0.997	0.992450
X^2_{NOR}	1.550630 (0.46055)	0.310810 (0.8560)
X^2_{SEC}	1.668149 (0.2370)	2.261215 (0.1833)
X^2_{HET}	2.506102 (0.0592)	1.201124 (0.4257)
R_m	1.983680 (0.0728)	0.304480 (0.7710)
W_{LR}		8.4128 (0.0108)
W_{SR}		7.1598 (0.065)

Source: Estimated by Authors.

Note(s): In the provided context, W_{LR} and W_{SR} stand for the Wald test of long and short-run symmetry conditions respectively. Additionally, X^2_{NOR} , X^2_{SEC} and X^2_{HET} represent tests for normality, serial correlation and heteroscedasticity respectively. Finally, R_m denotes the Ramsey reset test. P-values are given within parentheses.

Figure A-1: CUSUM and CUSUM of Squares' Tests



Source: Constructed by Authors.

India's Macro Fundamentals and Rupee-Dollar Exchange Rate Volatility: Results from Simple Sum and Divisia Money Measures

Topunuru Kaladhhar¹

Abstract

This study examines the relationship between Rupee-Dollar exchange rate volatility and volatility in macro fundamentals in times of financial innovation for India. The empirical analysis employs aggregation theoretic monetary aggregates (i.e., Divisia aggregates) as money supply measures for both India and US. The relevance of Divisia aggregates rest in the property of internalizing substitutions among different assets in response to interest rate changes as a result of financial innovation era since 1990s' economic reforms in India. The auto regressive lag distributive (ARDL) cointegration test is applied to determine the long run relationship between exchange rate volatility and macro fundamentals with Divisia and simple sum monetary aggregates as alternative money measures. The results reveal that Divisia aggregates based macro fundamentals yield better cointegration with exchange rates relative to simple sum aggregates. Hence, this paper supports Divisia money as an alternative money measure to track the movement of Rupee-Dollar exchange rate. It also suggests that monetary aggregates when measured by Divisia formulations could possibly render useful information in times of financial innovation.

JEL Classification Codes: : F3, F4

1. Introduction

The fluctuations in exchange rates affect all economic activities in this globalized world through the international trade and thereby causing the fluctuations in GDP growth rate and domestic consumption level. The origins of exchange rate volatility lies in the flexible exchange rate system adopted in 1973 by the advanced countries in spite of its objective to protect a country from severe external shock (Meese and Rogoff, 1983). India has been witnessing the enormous exchange rate volatility pressures with the shift to flexible exchange rate in March 1993 as a part of structural reforms to withstand to balance payment crisis in 1991. Prior to this shift, the Liberalized Exchange Rate Management System (LERMS) was enforced for one year period from early 1992 and end on March, 1993 with a dual exchange rate system. Under this system, all foreign exchange receipts on current account transactions needed

to be surrendered to the authorized dealers in full. For sixty percent of the transactions, proceeds the exchange rate was the market rate quoted by the authorized dealers (Dua and Ranjan, 2011).

In order to explain the movements of exchange rate under flexible exchange rate system, the monetary/macro models gained empirical support till 1970s. However, the seminal work by Meese and Rogoff (1983) observed a major aberration that monetary models are poor in terms of forecasting exchange rate relative to simple random walk model. This is further supported by studies like Baillie and Selover (1987), Neely and Sarn (2002). The failure of monetary model is attributed to instability in money demand function measured based on simple sum aggregates. To resolve instability issue, Chrystal and MacDonald (1995) employed the aggregation theoretic monetary aggregates i.e. Divisia aggregates in the monetary models during financial deregulation period for the

¹ Assistant Professor, Department of Economics, ICFAI Faculty of Social Sciences, Hyderabad, Telangana State- 503201, India. E-mail; tkaladhhar@ibsindia.org

Sterling-Dollar and the German-Mark rates. Their results reveal that Divisia monetary aggregates make a significant difference in modeling of the Sterling-Dollar exchange rate both in short and long runs.

Our study aims to study exchange rate volatility using Divisia aggregates as a money variable in empirical analysis of macro model as India has experienced financial innovation in the post reform regime. This is a significant research gap in the previous studies in India which have tested the long relationship between exchange rate and fundamentals using simple sum aggregates like M3 and M1 i.e., Ghosh (1998), Kletzer and Kohli (2000), Dua and Ranjan (2011), Bhanja et al. (2015). In case of studies examining exchange rate volatility, simple sum aggregates have been used such as Ghosh (2011), Goyal and Arora (2012) Kohli (2015). Saha and Biswas (2015) and Mahanty and Bhanumurty (2014).

The simple sum monetary aggregates are inappropriate as they produce unstable money demand functions. This is what Acharya and Kamaiah (2001) found while empirically studying money demand function for India and suggested that money demand functions with Divisia money were stable. Reserve Bank India (RBI, 1998) questioned the efficacy of simple sum aggregates with new developments in the financial system. The group also acknowledged the rationale underlying possible introduction of the Divisia type aggregates advocated by Barnett (1980).

Originally, Barnett (1980) and his coauthors proved and applied Divisia monetary aggregates in their research papers to capture the substitution effects following portfolio adjustments among monetary assets held by economic agents in response to changes in interest rate i.e. process of these assets in an economy. In fact, monetary assets or components of monetary aggregates published by the central banks in general are empirically regarded as imperfect substitutes

as they render both transaction and investment services in different degrees. However, all the central banks across world assume components as perfect substitute and weight them equally in simple sum aggregates. In 1980s, Divisia aggregates have drawn attention in the research field with empirical support in demand for money functions and other areas of macro-economic performance in studies such as Barnett (1980, 1990). Recently, Fuente et al. (2020) and Belongia and Ireland (2019) have reiterated the relevance of Divisia monetary aggregates to estimate stable money demand function and their relations with other macro fundamentals such as income and inflation.

The main objective of this study is to examine India's long run relation between the Rupee-Dollar exchange rate volatility and macro fundamentals by measuring money volatility with Divisia aggregates and compare with simple sum aggregates. Employing Divisia aggregates for the investigation of Rupee-Dollar volatility, and including joint covariance effect of macro fundamentals distinguish this study from previous studies. In pursuing above objectives, Autoregressive Distributive Lag Model (Pesaran et al., 2001) is applied.

The rest of the paper is organized as follows. Section 2 presents the monetary model of exchange rate determination and briefly reviews some major past studies. The third section discusses the construction and significance of Divisia aggregates. Section 4 presents data and methodology used in this study. The results are discussed in the fifth section. Finally, section 6 makes some policy implication and concluding remarks.

2. Monetary Model of Exchange Rates

The volatility of macro fundamental variable is obtained from flexible price monetary model (Frenkel,1976; Mussa,1976; Bilson,1978) for modelling of Rupee-Dollar exchange rate

volatility. Basically, it assumes that purchasing power parity (PPP) holds continuously.

$$e = p - p^* \quad (1)$$

where e denotes the natural logarithm of exchange rate that is defined as a price of domestic currency per unit of foreign currency: p and p^* with an asterisk denote domestic and foreign price variables measured in natural logarithms. The following equations represent money demand functions for domestic and foreign countries which are their respective monetary equilibrium conditions.

$$m - p = y - i \quad (2)$$

$$m^* - p^* = y^* - i^* \quad (3)$$

where m^* is domestic money supply, and m is foreign country's money supply. y is domestic income and y^* foreign country's money supply, i is domestic interest rate and i^* is foreign country's income. By rearranging (2) and (3), following expressions for domestic and foreign price levels are obtained.

$$p_t = m_t - \beta_2 y_t - \beta_3 i_t \quad (4)$$

$$p_t^* = m_t^* - \beta_2 y_t^* - \beta_3 i_t^* \quad (5)$$

By substituting (4) and (5) in equation (1), the following reduced form exchange rate equations is obtained

$$e_t = (m_t - m_t^*) + \beta_2 (y_t - y_t^*) + \beta_3 (i_t - i_t^*) \quad (6)$$

Equation (6) can be expressed in variance or volatility terms by multiplying it both sides with variance. It is ensued to volatility or variance of exchange rate that function of variance of macro fundamental differentials.

$$V_e = V_{\tilde{m}} + \alpha_1 V_{\tilde{y}} + \alpha_2 V_{\tilde{r}} + 2\alpha_2 \text{Cov}(\tilde{m}, \tilde{y}) + 2\alpha_2 \text{Cov}(\tilde{m}, \tilde{r}) + 2\alpha_2 \text{Cov}(\tilde{y}, \tilde{r}) \quad (7)$$

Where V is volatility and Cov is covariance and tilde ($\tilde{}$) over a variable stands for differential between domestic and foreign country. \tilde{m} , \tilde{y} ,

\tilde{r} denote domestic money supply, income and interest rate relative to foreign country, $\alpha_1, \alpha_2, \alpha_3$ are elasticity's of variance and covariance of monetary fundamental variables with respect to exchange rate variance or volatility. As per prior expectations, these coefficients are expected to be positively liked with exchange rate volatility or variance. But covariance of monetary fundamentals is either positive or negative relations with exchange rate volatility. Except for interest rate, all variables are in natural logarithm form. The volatility of exchange rate and money supply, income, interest rate between domestic and foreign countries are measured by three months exchange rate standard deviations following Balg and Metcalf (2010).

2.1. Divisia Monetary Aggregates

Barnett (1980,1990) proposed Divisia monetary aggregates by including aggregates theory, index numbers and monetary theory and theoretically demonstrated the significance and relevance of Divisia monetary aggregates as a case of emerging new financial instruments, products and services. Simple sum aggregates i.e. Broad money (M3), Narrow money (M1) and New Broad monetary aggregates (NM3) in case of India, the current practice of RBI or central banks are simple arithmetic sums assuming the components to be perfect substitutes of each other. They are arithmetically summing up their different combinations of components; currency with the public, demand deposits, and different time deposits. In reality, treating the different components is not appropriate as they are imperfect substitutes in nature. To circumvent this problem, Divisia index allocates different weights to different components in an aggregate according to the degree of transaction/monetary service provided. Thus, it distinguishes components that are held for transaction purposes from those held for investment services. For this purpose, monetary assets are assumed as durable goods Barnett (1978, 1980) derived from user-cost prices of their services. Thus, the expenditure

share of the services of component/monetary asset i in period t is given by

$$S_{it} = \frac{p_{it}m_{it}}{\sum p_{jt}m_{jt}} \quad (8)$$

where, m_{it} is monetary asset i at time t .

Finally, "The Divisia monetary aggregates" are produced by substituting into the Divisia quantity index formula, the quantities of individual monetary assets and their corresponding user-cost prices. Thus, the rate of growth of Divisia monetary aggregate (quantity index) is given by

$$\sum_{i=1}^n s_{it}^* (\ln m_{it} - \ln m_{it-1}) = \ln M_t - \ln M_{t-1} \quad (9)$$

where $s_{it}^* = 1/2(s_{it} + s_{it-1})$. The growth rate of the Divisia index is a weighted average of the growth rate of the monetary components where weight of each component is the user cost adjusted expenditure share of that component.

It is evident from this formulation that components weighted more are those with higher transaction/liquidity services and less interest rate return. Hence, Divisia aggregates internalize substitution effect among components responding to changes in interest rate in the economy. The economies undergoing financial innovation often see introduction of new financial assets that are interest bearing in nature. In such scenario the use of Divisia monetary aggregates assume crucial significance in adequately measuring liquidity in the economy.

3. Data and Methodology

This study uses quarterly time series data on Rupee-Dollar exchange rate and macro fundamentals. According to the availability of data, time series between 1996:q3- 2020:q2

is employed. The quarterly observations are measured following Balg and Metcalf (2010) where the authors calculate standard deviation every three months capturing the movement from one period to the next². Further, the data being limited on component of NM3 to calculate Divisia index NM3, the empirical exercise with DNM3-DM2 is confined to data period spanning between 1999:q2-2020:q2. Data is sourced from Hand Book of Statistics on Indian Economy, RBI and FRED. Details of Divisia money for various monetary aggregates, its component and their assumed returns are given in Annexure-1.

The simple sum monetary aggregates are proxied alternatively by Broad money (M3) and New Monetary Aggregates (NM3) for India. Divisia Aggregates/ index on M3 (DM3) and NM3 (DNM3) for India are calculated by adjusting the components of M3 and NM3 based on their respective weights measured using their own rate of returns following equation (8). Yield rate on SBI Prime Lending rate is used as a proxy for Benchmark Lending Rate. Income of India is proxied by monthly Index of Industrial Production. Income for US is measured by monthly Industrial Production Index. Interest rates of India and US are proxied by monthly Weighted Average Call Money rate and Effective Federal Fund Rates respectively. Except interest rate differentials, Money supplies and incomes are seasonally adjusted and also in the logarithms form.

In order to test the long run relations among exchange rate volatility and volatility and macro fundamentals, ARDL cointegration test developed by Pesaran et al (2001) and Pesaran and Shin (1999) is applied in which F bound test is employed to determine the long run relation among variables under the investigation in case of integration of variables at the combination of

² $SD = \sqrt{\frac{\sum (x - \bar{x})^2}{n}}$ where x is three months average of x and n is sample size.

I(0) and I(1) or only I(0). This methodology is plausible if more than two time series variables are stationary at either I(1) or I(0) or combination of both. Thus, it avoids the pre-testing of unit root problem associated with conventional methods. Further, the problem of endogeneity is less as long as the model is free from residual correlation. The ARDL model is specified as follows in the context of exchange rate volatility equation (5) where dependent variables can be distinguished from explanatory variables.

$$\Delta V e_t = C + T + \sum_{i=1}^{n_1} b_i \Delta V \tilde{m}_{t-1} + \sum_{i=1}^{n_2} c_i \Delta V \tilde{y}_{t-1} + \sum_{i=1}^{n_3} d \Delta V \tilde{r}_{t-1} + \sum_{i=1}^{n_4} e_i \Delta e_{t-1} + \sum_{i=1}^{n_5} f_i \Delta \tilde{m} \tilde{y}_{t-1} + \sum_{i=1}^{n_6} g_i \Delta \tilde{m} \tilde{r}_{t-1} + \sum_{i=1}^{n_7} h_i \Delta \tilde{y} \tilde{r}_{t-1} + \delta_1 V \tilde{m}_{t-1} + \delta_2 V \tilde{y}_{t-1} + \delta_3 V \tilde{r}_{t-1} + \delta_4 V e_{t-1} + \delta_5 \tilde{m} \tilde{y}_{t-1} + \delta_6 \tilde{m} \tilde{r}_{t-1} + \delta_7 \tilde{y} \tilde{r}_{t-1} + \mu_t \quad (10)$$

where Δ denotes first difference operator, c denotes drift component, T is trend, μ_t is white noise residuals and $V \tilde{m}$, $V \tilde{y}$, $V \tilde{r}$, $Cov(\tilde{m} \tilde{y})$, $Cov(\tilde{m} \tilde{r})$, $Cov(\tilde{y} \tilde{r})$ are variance or volatility of money supply, income, interest and their respective covariance.

In this ARDL eq. (10), null hypothesis of no long-run cointegration ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$) is tested against an alternative hypothesis of cointegration ($\delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 \neq 0$) using F test. Pesaran et al. (2001) generates two sets of critical values. One set assumes all variables are I(1) while other assumes that all variables are I(0) that contains a band covering all possible combination for each I(0) and I(1) variable. The null hypothesis of no cointegration is rejected to confirm the long run relationship among variables if calculated F statistics is more than critical F value. According to Pesaran et al. (2001), it allows for estimation of following unrestricted error correction model where optimum lags are decided by Akaike information Criterion (AIC) or Schwarz Bayesian Criterion (SBC).

$$\Delta V e_t = C + T + \sum_{i=1}^{n_1} b_i \Delta V \tilde{m}_{t-1} + \sum_{i=1}^{n_2} c_i \Delta V \tilde{y}_{t-1} + \sum_{i=1}^{n_3} d \Delta V \tilde{r}_{t-1} + \sum_{i=1}^{n_4} e_i \Delta e_{t-1} + \sum_{i=1}^{n_5} f_i \Delta \tilde{m} \tilde{y}_{t-1} + \sum_{i=1}^{n_6} g_i \Delta \tilde{m} \tilde{r}_{t-1} + \sum_{i=1}^{n_7} h_i \Delta \tilde{y} \tilde{r}_{t-1} + \gamma EC_{t-1} + v_t \quad (11)$$

where γ is coefficient of lags error correction term which measures the speed of adjustment parameters. EC_{t-1} is the residuals extracted from estimated model (10).

Further, to check the validity of the fitted models in terms of no serial correlation and no heteroscedasticity, Breusch-Godfrey (BG-LM) serial correlation LM test and ARCH tests are conducted on residuals. BG-LM test presumes the null hypothesis of no serial correlation in the residuals while ARCH test has the null hypothesis of no heteroscedasticity in the residuals of fitted model. Also Jarque-Bera (JB) test is held to test normal distribution of residuals of fitted model. Ramsay Reset test is conducted for whether the model is misspecified or not. Further, since the timeseries models are well known for instabilities so that the Cusum and Cusum square test are performed (Brown et al., 1975) for whether the estimated coefficients of model is stable or not over time.

4. Empirical Results and Discussion

This section presents and discusses the results of our main empirical relationship between exchange rate volatility and its fundamentals. Before that descriptive statistics of log of variance of Rupee-Dollar exchange rate and volatility in the fundamentals are presented in the **Table 1**. The table indicates the presence of variance or volatility in the Rupee-Dollar exchange rate and its macro variables with the different monetary aggregates in terms of standard deviation and skewness.

Table 1: Descriptive statistics of variables used in estimations

	e	DM3-DM2	M3-M2	NM3-M2	DNM3-DM2	r-r*	y-y*
Mean	3.92	1.82	6.18	2.31	1.00	-0.23	4.43
Median	3.85	1.84	6.29	2.25	1.05	-0.14	4.02
Std. Dev.	0.20	0.10	0.61	0.41	0.19	0.34	2.71
Skewness	0.41	-0.32	-0.26	0.16	-0.42	-0.25	0.98
JB	18.93	26.01	27.17	29.91	27.71	33.31	676.44

Source: Author's calculations.

The unit root test results in Table 2 are estimated through ADF and PP test with constant and constant plus trend to check integration or stationarity of variable at different level. Each volatility and covariance variable is integrated at I(0). This indicates the reject of null of unit root or non-stationary either with constant and constant plus trend. However, one of the other tests, ERS point optimal unit root test demonstrates all variables are I(0) except in case of income variable (y-y*) which is I(1). ARDL cointegration test is appropriate to determine the long run relationship because income variable is stationary at I(1) and all other variables are I(0). This facilitates cointegration test for series that is either stationary I(0) or non-stationary I(1), and in a mixed order of conditions I(0) and I(1). The same is quoted in Pesaran et al.(2001) as “following the methodology

i.e., ARDL developed in this paper, it is possible to test for the existence of a real wage equation (their study's empirical equation) involving the levels of these five variables irrespective of whether they are purely I(0), purely I(0), or mutually cointegrated”. ARDL is comparatively better than standard OLS regression and other earlier models like Engle and Granger (1987), Phillips and Hansen (1990), Johansen (1988), and Johansen and Juselius (1990). This approach ensures more consistent estimates, despite the small sample size (Pesaran and Shin, 1999). Also it may be possible to estimate the long-run and short-run parameters simultaneously and retain all model information by utilizing this approach. Further, the ARDL model addresses the eventual phenomenon of endogeneity among the explanatory variables (Pesaran et al., 2001).

Table 2: Summary of Unit Root Tests

Variables	ADF		PP	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
V e	-3.865***	-7.107***	-6.719***	-7.124***
V(m(M3)-m*(M2))	-7.746***	-8.206***	-7.935***	-8.324***
V(m(NM3)-m*(M2))	-8.067***	-8.423***	-8.241***	-8.541***
V(m(DM3)-m(Dm2)*)	-5.741***	-5.758***	-5.741***	-5.758**
V(m(NM3)-m(DM2)*)	-5.705***	-5.676***	-5.705***	-5.676***
(y-y*)	-8.265***	-8.921***	-8.617***	-8.980***

Variables	ADF		PP	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
(r-r*)	-6.610***	-7.390***	-6.968***	-7.672***
Cov(M3,y)	-6.133***	-6.090***	-9.820***	-9.755***
Cov(M3,r)	-8.552***	-8.502***	-8.606***	-8.548***
Cov(M3,y)	-5.821***	-5.976***	-8.410***	-8.650***
Cov(NM3,y)	-6.099***	-6.062***	-9.782***	-9.726***
Cov(NM3,r)	-8.226***	-8.187***	-8.200***	-8.156***
Cov(DM3,y)	-8.678***	-8.697***	-8.678***	-8.693***
Cov(DM3,r)	-8.521***	-8.577***	-8.524***	-8.571***
Cov(DNM3,y)	-8.272***	-8.246***	-8.270***	-8.244***
Cov(DNM3,r)	-7.221***	-7.244***	-7.620***	-7.639***
Cov(y,r)	-5.821***	-5.976***	-8.410***	-8.650***
Variables	ERS Point optimal test		KPSS	
	Intercept	Intercept +Trend	Intercept	Intercept +Trend
V e	-2.741***	-3.687***	0.623	0.126
V(m(M3)-m*(M2))	-2.775***	-8.233***	-0.547	0.168
V(m(NM3)-m*(M2))	-2.566**	-8.320***	-0.497	0.183
V(m(DM3)-m(DM2)*)	-5.753***	-5.191***	0.154	0.082
V(m(NM3)-m(DM2)*)	-4.925***	-5.124***	0.146***	0.119
(y-y*)	0.945	2.991	0.479	0.148
(r-r*)	-2.239**	-7.435***	0.506	0.128
Cov(M3,r)	-2.456**	-3.608**	0.203	0.110
Cov(M3,y)	-7.796***	-13.704***	0.099	0.052
Cov(NM3,y)	-5.450***	-5.911***	0.065	0.106
Cov(NM3,r)	-7.074***	-7.946***	0.132	0.098
Cov(DM3,y)	-6.295***	-7.796***	0.099	0.052
Cov(DM3,r)	-2.456**	-3.608**	0.203	0.110
Cov(DNM3,y)	-8.069***	-8.081***	0.088	0.668
Cov(DNM3,r)	-7.142**	-7.053**	0.172	0.141
Cov(y,r)	0.861	-1.747	0.143	0.058
$\Delta(y-y^*)$	5.473***	16.155***	0.026	0.235

Source: Author's calculations.

Notes: ***, **, * indicates the level of significance at 1%, 5% and 10% significance levels, respectively.

To confirm the presence of cointegration among the given variables with different monetary aggregates, ARDL Bound F test is conducted and result of which are presented Table 3. These results show cointegration between exchange rate volatility and volatility and covariance in the fundamentals as calculated F statistic at lag 6 is more than upper bound critical values with each monetary aggregate. This implies the rejection of null hypothesis for no cointegration among exchange rate volatility and volatility and covariance of fundamentals. Thus, the monetary fundamental volatility and covariance determines that Rupee-Dollar exchange rate volatility. This result implies that central bank can use the monetary policy to control exchange rate volatility effectively by influencing money supply, interest rate and income.

The results show that most of the long run coefficients are statistically significant and bear theoretically expected signs. Volatility in money, income and interest rate variables relative to US are positively associated with Rupee-Dollar exchange rate volatility. In the case of Divisia aggregates, interest rate volatility is negatively related exchange rate volatility. The positive money coefficients are consistent with theory implying more money in the domestic country compared to foreign country leads to more volatility in exchange rate volatility. Similarly, the positive coefficients of income volatility suggest that more income in domestic country relative to foreign country leads to more volatility in exchange rate. Positive income growth with either higher investment or higher government spending, results in more exports and higher exchange rate volatility (Grydaki and Fountas, 2009). In fact, income output effect depends on trade share in total output (Morana, 2009). The insignificant negative interest rate coefficient explain, according to Goyal and Arora (2012), shows the gap between Indian call money rate and the federal

funds rate and leads to arbitrage opportunities and therefore induces capital inflows such as short-term carry trade. This leads to huge volatility in the Rupee-Dollar exchange rate. This result is consistent with Grossmann et al. (2014) in which interest rate volatility leads more volatility in the exchange rate volatility. The negative interest rate coefficient of interest rate volatility with DNM3-DM2 is attributed to equity flows relative to share of debt flows owned by India. Higher interest rate volatility backed by the larger amount of equity flows associated with good market sentiments and confidence on Indian economy leads to lesser Rupee-Dollar volatility (Kohli 2015).

The estimated coefficients of covariance variables are obtained with the same signs for both simple sum and Divisia aggregates. The covariance between money and interest rate, and covariance between money and income are associated negatively with Rupee-Dollar exchange rate volatility while covariance between income and interest are positively linked with Rupee-Dollar exchange rate volatility. The negative coefficient of covariance between money and interest rate indicates that increased interest rate results into reduction of money supply with higher saving and lesser demand for domestic money and thereby appreciation exchange rate and lead to lesser volatility. Similarly, the negative coefficient of money supply and income suggests that a rise in income leads to more imports and increased domestic demand for money associated with lesser inflation and higher interest rate may result into appreciation of exchange rate and lesser exchange rate volatility. On contrary, the covariance coefficient between interest rate and income signifies that increased income with lower interest rate brought by higher money supply or higher government spending causes the depreciation of domestic currency and positive volatility of exchange rate.

Table 3: ARDL Bound Test Results

Exchange rate Volatility eq (7) with Monetary Aggregates	I(0)	I(1)	F-Statistic
M3 -M2	2.04	3.24	6.877**
NM3-M2	2.04	3.24	7.31***
DM3 -DM2	2.04	3.24	6.823***
DNM3-DM2	2.04	3.24	6.16***

Source: Author's calculations.

** indicates 5% level of significance at lag 6 as per AIC.

The results of error correction model with different monetary aggregates are reported in Table 4 and 5 of panels a. Lagged variance and covariance of monetary fundamentals significantly affects the Rupee exchange rate volatility in short run despite their sign are contradicted with expected ones. Thus, volatility in the monetary fundamentals influence exchange rate fluctuation in the short run. The coefficients of EC_{t-1} with the alternative set of monetary aggregates are significant and negative sign indicate that volatility in monetary fundamentals with both simple sum and Divisia monetary aggregates are able to bring exchange rate volatility back to its long-run equilibrium values. This results support for above the long-run relationship between the volatility in Rupee-Dollar exchange rate and volatility for fundamentals. However, the magnitude of the

speed of adjustment between simple sum and Divisia aggregates are not identical. For instance, EC_{t-1} coefficient with M3-M2 and NM3-M2 are 0.37% and 0.55% respectively while in the equation with DM3-DM2 and DNM3-DM2, it has been 0.56 % and 0.57 % respectively. It means that exchange rate volatility adjustment with Divisia aggregates is greater than that adjustment has brought in exchange rate with conventional simple sum aggregates in the following month. It indicates the macro fundamentals with Divisia aggregates are faster than that of simple sum aggregates in bringing back exchange rate to its long run equilibrium values. This substantiates our hypothesis that Divisia aggregates are more plausible to explain and predict exchange rate volatility than that of simple sum aggregates in the times of financial innovation.

Table 4: The Results of ARDL

Exchange rate Volatility Eq (7) with M3-M2		Exchange rate Volatility Eq (7) with NM3-M2	
Variable	Coefficient	Variable	Coefficient
(a) Short Coefficients and Error Correction Regression			
$\Delta V \tilde{m}_{t-1}$	1.432	$\Delta V \tilde{m}$	0.147
$\Delta Cov(\tilde{m} \tilde{y})$	25.869	$\Delta Cov(\tilde{y} \tilde{r})$	0.009
$\Delta Cov(\tilde{m} \tilde{y})_{t-1}$	-13.697**	$\Delta Cov(\tilde{m} \tilde{y})$	9.134***
$\Delta V \tilde{m}_{t-2}$	2.0144***	$\Delta Cov(\tilde{m} \tilde{y})_{t-1}$	9.114***
$\Delta Cov(\tilde{m} \tilde{r})_{t-1}$	0.559	$\Delta Cov(\tilde{m} \tilde{r})_{t-1}$	
$\Delta Cov(\tilde{m} \tilde{r})$	-1.178***	EC_{t-1}	
$\Delta Cov(\tilde{m} \tilde{r})_{t-1}$	-0.536***		
EC_{t-1}	-0.370***		

Exchange rate Volatility Eq (7) with M3-M2		Exchange rate Volatility Eq (7) with NM3-M2	
Variable	Coefficient	Variable	Coefficient
b) Long run Coefficients			
$V(\bar{m})$	6.754***	$V(\bar{m})$	1.154***
$V(\bar{y})$	0.423***	$V\bar{y}$	0.403***
$V\bar{r}$	-0.0025	$V\bar{r}$	-0.002
$Cov(\bar{y}\bar{r})$	0.391	$Cov(\bar{y}\bar{r})$	0.315
$Cov(\bar{m}\bar{y})$	-86.437*	$Cov(\bar{m}\bar{y})$	-22.147***
$Cov(\bar{m}\bar{r})$	3.533	$Cov(\bar{m}\bar{r})$	0.2315
(c) Statistics and Diagnostics			
R ²	0.471	R ²	0.4665
DW	2.001	DW	2.035
JB	62.917***	JB	46.885**
ARCH (3)	0.339	ARCH (3)	0.237
BG-LM (3)	1.470	BG LM(1)	2.130

Source: Author's calculations.

***, **, * indicate 1%, 5% and 10% level of significance, respectively.

\bar{m} , \bar{y} , \bar{r} denote (m-m*), (y-y*), (r-r*) respectively.

BG-LM test is Breusch-Godfrey Serial Correlation LM Test. for serial correlation.

ARCH is heteroscedasticity test for heteroscedasticity.

JB is Jarque Bera test for non-normality distribution of residuals.

RESET is Ramsay's specification test for correct functional form of model.

Table 5: The Results of ARDL

Exchange rate Volatility Eq (7) with DM3-DM2		Exchange rate Volatility Eq (7) with DNM3-DM2	
Variable	Coefficient	Variable	Coefficient
(a) Short Coefficients and Error Correction Regression			
$\Delta(V\bar{m})_{t-1}$	0.144	$\Delta(V\bar{m})_{t-1}$	0.794**
$\Delta(V\bar{r})_{t-1}$	-0.001**	$\Delta(V\bar{m}\bar{y})_{t-1}$	10.143**
$\Delta Cov(\bar{m}\bar{y})_{t-1}$	-4.726	$\Delta Cov(\bar{m}\bar{r})_{t-1}$	-0.047***
$\Delta Cov(\bar{m}\bar{r})_{t-1}$	-0.020	$\Delta Cov(\bar{m}\bar{r})_{t-1}$	-1.163***
$\Delta Cov(\bar{m}\bar{r})_{t-2}$	-0.359***	EC_{-1}	-0.565***
EC_{t-1}	-0.573***		
b) Long run Coefficients			
$V(\bar{m})$	0.873***	$V(\bar{m})$	2.776***
$V(\bar{y})$	0.382***	$V(\bar{y})$	0.422***
$V(\bar{r})$	0.005	$V(\bar{r})$	-0.003
$Cov(\bar{y}\bar{r})$	0.459*	$Cov(\bar{y}\bar{r})$	0.588**
$Cov(\bar{m}\bar{r})$	0.673	$Cov(\bar{m}\bar{r})$	2.641

Exchange rate Volatility Eq (7) with DM3-DM2		Exchange rate Volatility Eq (7) with DNM3-DM2	
Variable	Coefficient	Variable	Coefficient
(c) Statistics and Diagnostics			
R ²	0.475	R ²	0.428
DW	2.026	DW	2.013
JB	74.199***	JB	91.599***
ARCH(3)	0.377	ARCH (3)	2.125
LM(1)	2.454	LM(1)	0.409
RESET	1.746	RESET	0.894

Source: Author's calculations.

***, **, * indicate 1%, 5% and 10% level of significance, respectively.

\bar{m} , \bar{y} , \bar{r} denote (m-m*), (y-y*), (r-r*) respectively.

BG-LM test is Breusch-Godfrey Serial Correlation LM Test. for serial correlation.

ARCH is heteroscedasticity test for heteroscedasticity.

JB is Jarque Bera test for non-normality distribution of residuals.

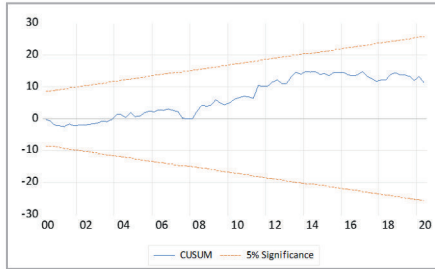
RESET is Ramsay's specification test for correct functional form of model.

The diagnostic statistics reported under (c) in Table 4 and 5 from Breusch-Godfrey Lagrange Multiplier and ARCH test suggest there is no autocorrelation at lag 1 and heteroscedasticity at lag 3 in the residuals at 5 % statistical significance level. Or, all estimated models are free from auto correlation and heteroscedasticity in the residuals. Despite of non-normally distributed of the residuals of each models, as Jara-Barque statistics are statistically significant at 5 % level, they do affect our estimates with the larger sample data size. Further, the functional form of each model is correctly specified as the significant statistics are obtained in Ramsay Reset test.

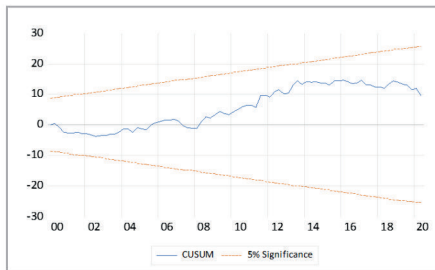
Finally, CUSUM and CUSUM of square tests proposed by Brown et al. (1975) are applied to see the stability of coefficient in the long run relationship between exchange rate volatility and volatility monetary fundamentals. These tests are

exercised on the cumulative sum and cumulative squared sum of recursive residuals on the initial set of n observations. The same CUSUM and CUSUM of square are updated recursively and their statistics are plotted against the break points at 5 % level. To consider the estimated coefficient model as stable, these statistics lie within 5 % level. The plots of CUSUM and CUSUM of Square of models with different monetary aggregates are plotted in the **Figures 1 and 2**. They suggest no coefficients of models with simple sum aggregates are stable except model with simple sum aggregates measured by M3-M2 as these statistics crossing point of bands indicated by dashed line. However, M3-M2 could provide stable coefficients for the relation of exchange rate volatility and macroeconomic volatility. This indicates that the estimated coefficients are turned to be unstable at times of crisis such Great Financial crisis 2008, and Greece debt crisis 2013.

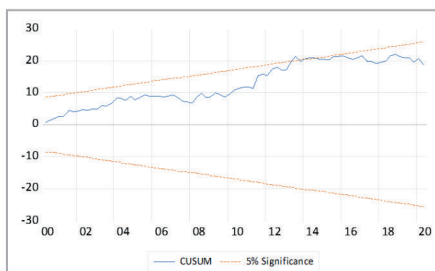
Figure 1



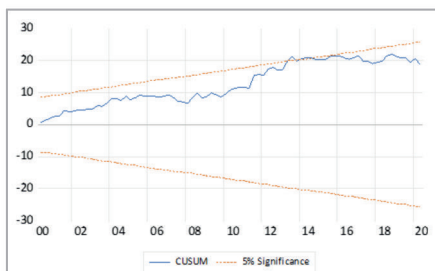
(a)



(b)

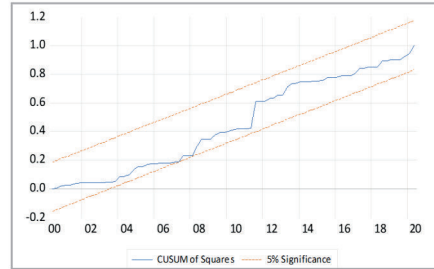


(c)

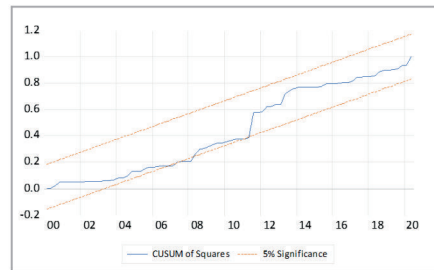


(d)

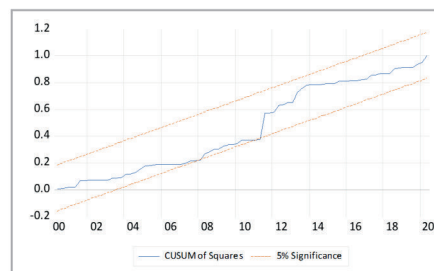
Figure 2



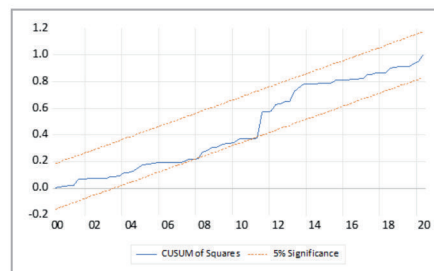
(b)



(f)



(g)



(h)

Figure 1: CUSUM indicates the Cumulative Recursive Residuals.

Figure 2: CUSUM of squares indicates the CUSUM of squares indicates the Squares of Cumulative Recursive Residuals.

To sum up, the above results offer evidence for the presence of a long run relationship between the volatility in macro fundamentals and volatility in Rupee-dollar exchange rate. Macro fundamentals are major determinants of exchange rate. This has a policy implication for the Reserve Bank of India as can control exchange rate fluctuations by targeting interest rate or monetary aggregates through monetary policy. In addition, the result suggests Divisia aggregates are in one or other way relevant in capturing dynamics of exchange rate data differently in the time of financial innovation.

5. Conclusion and Policy Implications

This paper estimated the impact of volatility in monetary fundamentals on Rupee-Dollar exchange rate volatility by using simple sum and Divisia monetary aggregates in India. The rationale underlying the Divisia aggregates is the property of accommodating the imperfect substitution among monetary assets and each asset weighted based on its user cost in the aggregates. ARDL cointegration methodology is used to test the long run relationship between exchange rate volatility and macro fundamentals.

Overall results provide supporting evidence for a long-run cointegration for volatility for Rupee-Dollar exchange rate and monetary fundamental that includes either conventional or Divisia monetary aggregates. Speed of adjustment to its long-run equilibrium of exchange rate is brought better by Divisia aggregates based monetary fundamentals than simple sum aggregates monetary aggregates. This result implies the relevance of Divisia aggregates to track the movement of Rupee-Dollar exchange rate.

The paper draws the major policy implication that central bank could control exchange rate fluctuations by targeting interest rate or monetary aggregates through its monetary policy. The results of this study support for Divisia aggregates as a tool to analyze the Rupee-Dollar exchange rate. At the same time, ability of Divisia aggregates cannot

be overlooked in measuring demand for money function in addition to simple sum aggregates as they provides the relevant monetary information to frame exchange rate and monetary policies by RBI.

This study is extendable in future to include capital flows, and structural breaks based on policy changes and economics or financial crises.

References

- Acharya, D., & Kamaiah, B. (2001). Simple sum versus Divisia monetary aggregates: an empirical evaluation. *Economic and Political Weekly*, 36 (4), pp. 317-326.
- Balg, B. A., & Metcalf, H. (2010). Modeling exchange rate volatility. *Review of International Economics*, 18(1), 2010.
- Barnett, W. A. (1978). The user cost of money. *Economics Letters*, 1(2), pp. 145-149.
- Barnett, W. A. (1980). Economic monetary aggregates an application of index number and aggregation theory. *Journal of Econometrics*, 14(1), pp. 11-48.
- Barnett, W.A. (1990). Developments in monetary aggregation theory. *Journal of Policy Modelling*, 12(2), pp. 205-257.
- Bilson, J. F.O. (1978). The monetary approach to the exchange rate: some empirical evidence. *IMF Staff Paper*, 25(1), pp. 48-75.
- Belongia, M. & Ireland, P. (2019). The demand for Divisia Money: theory and evidence. *Journal of Macroeconomics*, 61, pp. 103-128.
- Bhanja, N., Dar, A. B., & Tiwari, A. K. (2015). Exchange rate and monetary fundamentals: long run relationship revisited. *Panoeconomicus*, 62 (1), pp. 33-54.

- Baillie R T, Selover D D (1987) Cointegration and models of exchange rate determination. *International Journal of Forecasting* 3, pp.43-51.
- Brown, R. L., Durbin, J., & Evans, J. M. (1975). Techniques for testing the constancy of regression relations over time. *Journal of the Royal Statistical Society, Series B*, 37(2), pp. 149-192.
- Chrystal, K. A., & MacDonald, R. (1995). Exchange rates, financial innovation and Divisia money: the sterling/dollar rate 1972–1990. *Journal of International Money and Finance*, 14(4), pp. 493-513.
- Dua, P., & Ranjan, R. (2011). Modelling and forecasting the Indian re/us dollar exchange rate. Centre for Development Economics, Delhi School of Economics Working Paper No.197.
- Engle, R.F. & Granger, C.W.J. (1987), “Cointegration and error correction representation: estimation and testing”, *Econometrica: Journal of the Econometric Society*, pp. 251-276.
- Frenkel, J. A. (1976). A monetary approach to the exchange rate: doctrinal aspects and empirical Evidence. *The Scandinavian Journal of Economics*, 78, pp. 200-224.
- Fuente, G.D.L., Horra, P.D.L., & Perote, J. (2020). The demand for Divisia money in the United States: evidence from the CFS Divisia M3 aggregate, *Applied Economics Letters*, 27(1), pp. 41-45.
- Ghosh, M. (1998). Structural break and cointegration test of the monetary exchange rate model. *Keio Economic Society*, 35(1), pp. 67-77.
- Ghosh, S. (2011). Examining crude oil price – exchange rate nexus for India during the period of extreme oil price volatility. *Applied Energy*, 88, pp. 1886–1889.
- Goyal, A., & Arora, S. (2012). The Indian exchange rate and central bank action: an EGARCH analysis. *Journal of Asian Economics*, 23, pp. 60-72.
- Grossmann, A., Love, I., & Orlov, A. G. (2014). The dynamics of exchange rate volatility: A panel VAR approach. *Journal of International Financial Markets, Institutions & Money*, 33, pp. 1–27.
- Grydaki, M., & Fountas, S. (2010). What explains nominal exchange rate volatility? evidence from the Latin American countries. Discussion paper series 2010 Department of Economics, University of Macedonia.
- Johansen, S. & Juselius, K. (1990), “Maximum likelihood estimation and inference on cointegration with applications to the demand for money”, *Oxford Bulletin of Economics and Statistics*, Vol. 52 No. 2, pp. 169-210.
- Johansen, S. (1988). *Statistical Analysis of Cointegrating Vector*. *Journal of Economic Dynamics and Control*, 12, pp. 231-354
- Kletzer, K., & Kohli, R. (2000). Exchange rate dynamics with financial repression: a test of exchange rate models for India. Indian Council for Research on International Economic Relations, Working paper No. 52.
- Kohli, R. (2015). Capital flows and exchange rate volatility in India: how crucial are reserves? *Review of Development Economics*. 19(3), 2015. pp. 577-591.
- Meese, R. A., & Rogoff, K. (1983). Empirical exchange rate models of the seventies: do they fit out of sample? *Journal of International Economics*, 14(1-2), pp. 3-24.
- Mussa, M. (1976). The exchange rate, the balance of payments and monetary and fiscal policy under floating exchange rate. *Scandinavian Journal of Economics*, 78(2), pp. 229-248.

- Mohanty, B., & Bhanumurthy, N. R. (2014). Exchange rate regimes and inflation: evidence from India. *International Economic Journal*, 28(2), pp. 311-332.
- Morana, C. (2009). On the macroeconomic causes of exchange rate volatility. *International Journal of Forecasting*, 25, pp. 328–350.
- Neely, C. J., & Sarno, L. (2002). How well do monetary fundamental forecast exchange rates? *Federal Reserve Bank of St.Louis, Review*, pp. 51-74.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16, pp. 289-326.
- Pesaran, M.H., & Shin, Y. (1999). An autoregressive distributed lag modelling approach to cointegration analysis. In: Strom, S., Diamond, P. (Eds.), *Centennial Volume of Ragnar Frisch*. Cambridge University Press.
- Phillips, P.C. & Hansen, B.E. (1990), “Statistical inference in instrumental variables regression with I (1) processes”, *The Review of Economic Studies*, Vol. 57 No. 1, pp. 99-125.
- Saha, A. K., & Biswas, S. (2014). Macroeconomic fundamentals and exchange rate volatility during the floating exchange rate regime in India. *International Journal of Economics and Management*, 8(1), pp.10 – 39.
- Reserve Bank of India. (1998). Money supply: analytics and methodology of compilation. Report of the Third Working Group (Chairman: Dr. Y.V. Reddy), Mumbai.

Annexure 1: Monetary aggregates measures used in the study

Monetary aggregate	Monetary components
M3 and Divisia M3 for India	Currency with the public + demand deposits with the banks + time deposits with the banks + other deposits with the RBI
NM3 and Divisia NM3 for India	Currency with the public + demand deposits with the banking system + other deposits with the RBI+ short-term deposits of residents (including and up to the contractual maturity of one year).+ certificates of deposits (CDs)+ long- term time deposits of residents + call/term funding from financial institutions.
M2 for US	Currency + traveler's checks+ demand deposits+ other checkable deposits (CDs)+savings deposits (which include money market deposit accounts, or MMDAs) +small-denomination time deposits (time deposits in amounts of less than \$100,000) + retail money market mutual funds (MMMFs)
Divisia M2 all for US	Currency + travelers' checks + demand deposits +other checkable deposits+ savings deposits+ +money-market deposit accounts +small- denomination time deposits+ retail and institutional money-market funds.
Monetary components and corresponding interest rate proxies	
Monetary Components	Interest rate
Currency with the public	Zero
Demand deposits with the banks	Zero
Other' deposits with the RBI	Zero
Time deposits with the banks	3 to 5 year deposits rate
Short-term time deposits	Call money rate
Certificates of Deposits	Call money rate
Long-term time deposits of residents	Above 5 years deposits rate
Call/Term funding from financial institutions	Above 5 year deposits rates
Benchmark rate	SBI Prime Lending rate
Refer the Centre for Financial Stability site to know about monetary components and their corresponding interest rates	

The List of Abbreviation

Abbreviation	Description
ADF	Augmented Dicky Fuller Test
AIC	Akaike Information Criterion
ARDL	Auto-Regressive Distributed Lag Model
ARCH	Autoregressive Conditional Heteroskedasticity
BG-LM	Breusch-Godfrey Lagrange Multiplier Test
CUSUM	Cummulative Sum
DW	Durbin Watson Test
DM3	Divisia M3 (Broad Money
DNM3	Divisia NM3 (New Monetary Aggregates)
DM2 all	Divisia M2 all
ERS	Elliott, Rothenberg and Stock (ERS) Point Optimal Test
GDP	Gross Domestic Product
JB	Jarque-Bera Test
KPSS	Kwiatkowski–Phillips–Schmidt–Shin Test
LERMS	Liberalized Exchange Rate Management System
M3	Broad Money
M1	Narrow Money
NM3	New Monetary Aggregate
PP	Phillips Perron Test
SBC	Schwarz Bayesian Criterion

The List of Notations

Notations	Description
~	Tilde
Δ	Delta
*	Asterisk
α	Alpha
μ	Mu
δ	Delta
γ	Gamma

Electric Vehicle Landscape in India: An Analysis of Two Wheeler Electric Vehicles Market Trends and Economic Policy Implications

Sanoop M S¹

Abstract

The electric vehicle market in India is steadily growing, with a simultaneous rise in the market share of two-wheeler electric vehicles. Various schemes and incentives launched by both central and state governments aim to promote electric mobility. In 2015, the Department of Heavy Industry (DHI) unveiled the Faster Adoption and Manufacturing of (Hybrid and) Electric vehicles (FAME) program, which currently serves as India's primary endeavor to advance electric mobility. This paper examines the overall progress of electric vehicle landscape in India focusing particularly on trends within the two wheeler electric vehicles market. The present study emphasizes performance metrics, challenges, and market analysis specific to two-wheeler electric vehicles in India and draws few economic policy implications. The insights from the current trend of electric vehicles sales are of significance relevance in the Electric vehicle industry's future trajectory, potentially indicate an Electric Vehicle Revolution in India in the years to come.

JEL Classification Codes: L91, Q55, R40, R49

1. Introduction

The automotive industry in India is one of the main pillars of the economy. With strong backward and forward linkages, it is a key driver of growth. Liberalization and conscious policy interventions over the past few years created a vibrant, competitive market, and brought several new players, resulting in capacity expansion of the automobile industry and generation of huge employment. India is the second largest manufacturer of 2 wheeler, the largest manufacturer of 3 wheeler and 3rd largest manufacturers of passenger cars in the world. The manufacturing of automobiles including truck, buses, cars, three wheeler/ two wheelers etc. in India has risen at a very high pace (Ministry of Heavy Industries, GOI).

The electric vehicles industry in India at an emerging stage. India has taken a Green initiative by promoting and manufacturing the Electric vehicles (EVs). EVs have the potential to solve interrelated problems such as air pollution, depletion of non-renewable energy sources,

increasing oil prices, rising oil imports, and demands for "green" development (Bradley, 2021, Lin and Wu, 2018, McCollum et al., 2018, Singh and Sharma, 2014). These EVs consists of buses, 4 wheelers, 3 wheelers and 2 wheelers. Currently, India's flagship scheme Faster Adoption and Manufacturing of (Hybrid and) Electric vehicles (FAME) started by the Ministry of Heavy Industries to promote the electric vehicles. It is less than 1percent of the total vehicle sales however has the potential to grow to more than 5 percent in a few years. At present there are more than 5 lac electric two-wheelers and few thousand electric cars on Indian roads (Ministry of Heavy Industries, GOI & SMEV)

In the EV revolution in India, the Electric two wheeler industry accounted for 55 percent of the total EV sales in Financial Year (FY) 2022 alone. As per the data on Vahan portal, 910,930 units of electric two wheelers (e2w) were sold in 2023-24, against 682,937 units in 2022-23.

¹ Assistant Professor, Department of Economics, University of Calicut, Dr. John Matthai Centre, Thrissur, Kerala-680618. E-mail: sanoopms119@gmail.com

The main objective of this paper is to examine the overall progress of electric vehicle landscape in India focusing particularly on trends within the two-wheeler electric vehicles market. The present study emphasizes performance metrics, challenges, and market analysis specific to two-wheeler electric vehicles in India. The electric vehicles in India aims to address the above said issues of the motor vehicles and provide a sustainable solution to those issues in India.

This paper is based on the secondary data from sources such as Vahan, Ministry of Road Transport & Highways, the Economic Survey, Society of Manufacturers of Electric Vehicles (SMEV), e-AMRIT (NITI Aayog), and Open Government Data (OGD) Platform India. The collected data undergoes analysis through a range of descriptive methods.

2. Electric Vehicles in India: An Overview

2.1. Growth of total Electronic Vehicles in India

Transport is a fundamental requirement of modern life, but the traditional combustion engine is quickly becoming outdated. Petrol or diesel vehicles are highly polluting and are being quickly replaced by fully electric vehicles. Fully electric vehicles (EV) have zero tailpipe emissions and are much better for the environment and it has lower running costs, low maintenance cost, zero tailpipe emissions (e-AMRIT, NITI Aayog, GOI). The table.1 displays the registered vehicle figures in India spanning from 1970-71 to 2019-20, clearly indicating a significant surge in vehicle registrations over the years. Notably, there was a 35 percent growth rate observed in vehicle registrations in 1980-81, which subsequently escalated to 91 percent by 2019-20.

Table 1: Number of Registered Vehicles

Year	All Vehicles (In 000's)
1970-71	1865
1980-81	5391
1990-91	21374
2000-01	54991

Year	All Vehicles (In 000's)
2011-12	159491
2012-13	176044
2013-14	190704
2014-15	210023
2015-16	230031
2016-17	253311
2017-18	272587
2018-19	295772
2019-20	326299

Source: Economic Survey, GOI – Various years.

The government has reduced the Electric Vehicle (EV) subsidy per unit to 15 percent of the ex-factory price from 40 percent for e-2Ws under FAME India Scheme Phase-II keeping in mind the increasing penetration of the EV market. The Government of India has taken many steps like FAME, Production Linked Incentive (PLI) scheme for automotive sector, PLI Scheme for Advanced Chemistry Cell (ACC), GST on EVs has been reduced from 12 percent to 5 percent; GST on chargers/ charging stations for EVs has been reduced from 18 percent to 5 percent. etc. to give incentives/ subsidies on electric vehicles to resolve structural challenges in adopting electric vehicles (Ministry of Heavy Industries , GOI).

Table. 2 provides a breakdown of electric vehicle sales in India categorized by vehicle type from 2018 to 2023. The table delineates five vehicle segments: two-wheelers, three-wheelers, four-wheelers, goods vehicles, and public service vehicles. Each column displays registrations for both motor vehicles and electric vehicles (EVs). The data illustrates a significant rise in EV registrations across all vehicle categories from 2018 to 2023, with particularly notable growth observed in three-wheeler EV sales, increasing from 14.4 percent in 2018 to 52.41 percent in 2023. This trend indicates a consistent upward trajectory over the years. Moreover, the two-wheeler segment also demonstrates substantial sales growth during this period, rising from 0.09 percent in 2018 to 5.28 percent in 2023.

Table 2: Sales of Electric Vehicles in India by Category of Vehicles

Vehicle Category	2018	2019	2020	2021	2022	2023**
Two Wheeler	19576235	18644700	14305129	13926217	15592118	9276337
EV	17067 (0.09)	30389 (0.16)	29113 (0.2)	156243 (1.12)	631181 (4.05)	489637 (5.28)
Three Wheeler	764806	765867	400893	390820	677034	572654
EV	110133 (14.4)	133489 (17.43)	90385 (22.55)	158129 (40.46)	350247 (51.73)	300114 (52.41)
Four Wheeler	2999288	2822782	2396428	2945340	3346973	2020459
EV	1047 (0.03)	962 (0.03)	3207 (0.13)	12259 (0.42)	33205 (0.99)	40186 (1.99)
Goods Vehicles	886047	799661	503358	602805	804409	490920
EV	658 (0.07)	54 (0.01)	15 (0)	1118 (0.19)	653 (0.08)	1512 (0.31)
Public Service Vehicle	79317	81022	40328	15434	45448	47058
EV	50 (0.06)	508 (0.63)	88 (0.22)	1177 (7.63)	1972 (4.34)	985 (2.09)

Source: data.gov.in (Open Government Data (OGD) Platform India).

* EV - Electric Vehicle; The figures in the parenthesis indicate percentages.

** data upto 01.08.2023.

Table 3: Number of Electric Vehicle Sales in India

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Grand Total	Financial Year		
									2024-25	April	May
E-2 Wheelers	2005	28007	26834	44803	252641	728054	944126	2026470	64100	9365	73465
E-3 Wheelers	91970	116031	143051	90898	172543	401882	632485	1648860	41123	6817	47940
E-4 Wheelers	1204	1885	2377	5154	18622	47499	90432	167173	6888	790	7678
E-Buses	19	66	434	373	1194	1984	3693	7763	221	55	276
Grand Total	95198	145989	172696	141228	445000	1179419	1670736	3850266	112332	17027	129359

Source: Society of Manufacturers of Electric Vehicles (SMEV).

Note: This data is as on 2nd April, 2024. It excludes Telangana. This data does not include Low Speed Sales, and includes subsidiaries & non subsidiaries sale.

2.2. Progress of Two Wheeler Electric Vehicles in India

This section focuses on the advancement of two-wheeler electric vehicles in India. Table. 3 provides an overview of electric vehicle sales across various categories from 2017-18 to 2024-25 (April 2024). Analysis of the sales progression across all categories during this period reveals a significant surge, with sales escalating from 95,198 in 2017-18 to 1,670,736 in 2023-24. Across various EV categories from 2017-18 to 2023-24, there has been a notable rise in the sales of E-2 wheelers vehicles, with a continued significant increase observed in the sales of 2-wheeler EVs in 2024-25 as well. The figure 1 clearly indicating that there is a huge upward increase in the sales of two wheeler EVs after 2020-21.

Table 4 illustrates the sales figures of electric two-wheeler vehicles from the fiscal years 2017-18 to 2024-25. It is evident that there has been a significant increase in sales over the years. When comparing the total sales between 2017-18 and 2023-24, there is a substantial surge in the number of two-wheeler EVs sold in India, rising from 2,005 in 2017-18 to 944,126 in 2023-24. Analyzing the monthly sales of two-wheeler EVs from April to March across these years reveals a consistent increase. Therefore, the table. 4 underscores the high demand for two-wheeler electric vehicles in India over the years, with the trend suggesting a further increase in demand in the foreseeable future.

Table 4: Number of Electric Two-Wheeler Sales in India

Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Total
2017-18	96	91	137	116	99	109	160	214	189	176	156	462	2005
2018-19	486	681	955	1281	1570	2258	2560	3311	3171	2745	3121	5868	28007
2019-20	3079	1668	1758	1568	1507	1558	2136	3147	2235	2942	2353	2883	26834
2020-21	85	558	1511	1488	2115	3089	2953	4188	4948	5319	6579	11970	44803
2021-22	5636	1315	4751	14692	16099	17959	20704	24503	26862	30041	35759	54320	252641
2022-23	52389	41727	44054	46584	53129	55124	78236	77376	65106	62891	66091	85347	728054
2023-24	66877	105582	46106	54614	62767	64077	75144	92018	75855	82018	82508	136560	944126
2024-25	64100	9365											73465

Source: Society of Manufacturers of Electric Vehicles (SMEV).

This data as on 2nd April, 2024. It excludes Telangana. This data does not include Low Speed Sales and includes subsidies & non subsidies sale.

Note : Jan - January, Feb - February, Mar - March, Apr - April, Jun - June, Jul - July, Aug - August, Sep - September, Oct - October, Nov - November, Dec - December.

3. Market Analysis of Two Wheeler Electric Vehicles in India

This section delves into the market analysis of two-wheeler EVs in India. Table. 5 provides insights into electric two-wheeler sales specifically

for the financial years 2018, 2019 and 2020. Among the various players in the two-wheeler EV industry in India, Okinawa Autotech held the largest market share in the financial years (FY) 2018 and 2020, accounting for 42 percent in FY 2018 and 39 percent in FY 2020. Hero Electric

dominated the market share in FY 2019, capturing 46 percent in that year, while Okinawa Autotech also maintained a significant market share in FY 2019. The remaining market share is held by other

manufacturers in the two-wheeler EV industry, with notable sales recorded in FY 2019 compared to other fiscal years.

Table 5: Electric Two-Wheeler Sales in the FY 2020

Maker	FY 2020	MS*	FY 2019	MS*	FY 2018	MS*
Hero Electric	7865	29%	12970	46%	393	20%
Okinawa Autotech	10544	39%	11256	40%	842	42%
Ather Energy	2905	11%	330	1%	0	0%
Ampere Vehicles	2518	9%	0	0%	0	0%
Revolt	1063	4%	0	0%	0	0%
Others	1939	7%	3451	12%	770	38%
Total	26834		28007		2005	

Source: Society of Manufacturers of Electric Vehicles (SMEV).

* MS -Market Share (%). This data is as per VAHAN Portal as on 10th January, 2023 and does not include Low Speed Sales.

Table. 6 analyzes the sales of electric two-wheelers across different financial years spanning from 2018-19 to 2023-24. A comparison with table 5 distinctly shows a significant expansion in the number of two-wheeler EV manufacturers in response to the burgeoning demand for such vehicles in India. Reviewing sales figures across these financial years reveals that Okinawa Autotech held the largest market share in the two-wheeler EV industry in India for 2018-19 and 2019-20, while Ather Energy and Revolt had the least market share in those respective years. However, for 2020-21 and 2021-22, Hero Electric emerged as the dominant player with market

shares of 36 percent and 27 percent, respectively, whereas Jithendra held the least market share in both years, at 1 percent and 2 percent respectively. In 2022-23 and 2023-24, Ola Electric captured the largest market share in India's two-wheeler EV market, while Jithendra held the least market share in 2022-23 and Hero Electric, Revolt, Okaya EV, Battre Electric, and Kinetic Green collectively held the least market share in 2023-24. The overall trend indicates a substantial increase in the sales of two-wheeler electric vehicles across all manufacturers over the years, reflecting the high demand for such vehicles in India. For instance, the total sales of two-wheeler EVs surged from 19,252 in 2018-19 to 944,126 in 2023-24.

Table 6: Electric Two-Wheeler Sales in Various Financial Years (FY)

Maker	2018-19	MS*	2019-20	MS*	2020-21	MS*	2021-22	MS*	2022-23	MS*	2023-24	MS*
Hero Electric	7703	40%	7865	29%	15956	36%	69235	27%	89874	12%	12094	1%
Okinawa Autotech	7822	41%	10544	39%	7129	16%	47926	19%	95939	13%	20873	2%
Ampere Vehicles	0	0%	2518	9%	6095	14%	25516	10%	87392	12%	55057	6%
Ather Energy	330	2%	2905	11%	4401	10%	19981	8%	76939	11%	108872	12%
Revolt	0	0%	1063	4%	1793	4%	7641	3%	12932	2%	7342	1%
Bajaj	8	0%	130	0%	1470	3%	7114	3%	32805	5%	106990	11%
Pure EV	0	0%	0	0%	2080	5%	14969	6%	11556	2%	0	0%
Being India	0	0%	25	0%	1151	3%	7374	3%	11018	2%	0	0%
Jithendra	0	0%	77	0%	639	1%	3875	2%	8563	1%	0	0%
TVS	25	0%	39	0%	838	2%	9740	4%	82109	11%	182959	19%
Ola Electric	0	0%	0	0%	0	0%	14405	6%	152779	21%	326443	35%
Okaya EV	0	0%	0	0%	0	0%	0	0%	13175	2%	14035	1%
Bgauss	0	0%	0	0%	0	0%	0	0%	0	0%	15235	2%
Battre Electric	0	0%	0	0%	0	0%	0	0%	0	0%	4901	1%
Kinetic Green	0	0%	0	0%	0	0%	0	0%	0	0%	9703	1%
Others	3364	17%	1668	6%	3251	7%	24865	10%	52973	7%	79622	8%
Total	19252		26834		44803		252641		728054		944126	

Source: Society of Manufacturers of Electric Vehicles (SMEV).

This data does not include Low Speed Sales.

*MS - Market Share.

From the preceding discussions, it is evident that there is a substantial demand for two-wheeler electric vehicles in India, with various manufacturers competing in the EV industry with varying performances. The trend suggests a significant percentage increase in electric vehicle registrations across the country due to their advantages over conventional motor vehicles. The number of EV registrations has surged from 130,254 in 2018 to 1,024,808 in 2022, showcasing a notable increase in EV registrations in India over the years. Remarkably, electric vehicle numbers

have risen in every state and Union Territory, as indicated in table 7, which provides state-wise details of electric vehicles in India. Upon analyzing this data, it becomes apparent that Uttar Pradesh leads in the number of EVs, followed by Maharashtra and Karnataka, while Arunachal Pradesh records the least number of EVs in India. As of August 3, 2023, the total number of electric vehicles in the country stands at 2,830,565. This trend suggests a significant growth in EV adoption in India, hinting at an imminent Electric Vehicle Revolution in the country's automotive landscape.

Table 7: The state wise details of electric vehicles

State/ UT	Total Number of Electric Vehicles*
Andaman & Nicobar Island	190
Andhra Pradesh	67,905
Arunachal Pradesh	28
Assam	1,20,423
Bihar	1,61,060
Chandigarh	7,964
Chhattisgarh	54,848
Delhi	2,33,212
Goa	12,615
Gujarat	1,38,410
Haryana	69,271
Himachal Pradesh	2,410
Jammu and Kashmir	10,896
Jharkhand	36,759
Karnataka	2,48,747
Kerala	98,332
Ladakh	65
Madhya Pradesh	96,151
Maharashtra	3,05,006
Manipur	1,203
Meghalaya	139
Mizoram	118
Nagaland	62
Odisha	62,567
Puducherry	4,588
Punjab	35,727

State/ UT	Total Number of Electric Vehicles*
Rajasthan	1,80,670
Sikkim	20
Tamil Nadu	1,73,152
Tripura	14,839
UT of DNH and DD	354
Uttar Pradesh	5,74,967
Uttarakhand	49,491
West Bengal	68,376
Grand Total	28,30,565

Source: Ministry of Road Transport & Highways.

Note: 1. The details given are for digitized vehicle records as per Vahan.

2 - Data for Telangana and Lakshadweep is not available.

*The data as on 03.08.2023.

4. Economic policy implications

In this section, we delve into the cost-benefit analysis and its economic policy implications from the consumer's perspective regarding EVs in India. Assuming that an individual travels approximately 40 kilometers (km) daily using a two-wheeler motor vehicle, incurring monthly expenses ranging from Rs. 3,200/- to Rs. 3,500/-, his yearly expenditure amounts to approximately Rs. 38,400/- to Rs. 42,000/-. He opts for a two-wheeler EV from a specific manufacturer with a range of 120 km per single full charge, priced at around Rs. 1,75,000/- inclusive of the government's FAME-II subsidy. According to the manufacturer, the battery life of this EV is around 3 years, with an option for an extended warranty of 2 years at an additional cost. Charging the two-wheeler EV at home incurs a cost of around ₹7.90/kilowatt-hour (kWh), while charging at a station costs approximately ₹15/unit. Utilizing the Journey Cost Calculator provided by e-AMRIT, NITI Aayog, Government of India, the aforementioned figures are computed. Consequently, the cost saving is ₹94.35, with an annual cost saving is approximately ₹34,437.75, achieved by transitioning to an electric vehicle instead of a conventional one. The annual fuel cost for the two-wheeler EV is ₹4,252/-, significantly

lower than the ₹38,690/- for a conventional two-wheeler. The cost per km for the two-wheeler EV is ₹0.29, compared to the conventional two-wheeler's ₹2.65. Thus, the cost-benefit analysis reveals that purchasing a two-wheeler EV offers numerous advantages over an internal combustion engine (ICE) vehicle.

During last few years, global market of EVs have witnessed rapid growth due to multiple environmental, societal and health benefits of EVs over internal combustion engines (ICEs) (International Energy Agency, 2019). India has already pledged that 30 percent of all new vehicle sales in the country will be EVs by the year 2030 (Das and Bhat, 2022; Kumar and Alok, 2020). The market for two-wheeler electric vehicles (EVs) in India is rapidly growing and has significant economic implications like economic growth and job creation, energy security and import bill reduction, environmental and Health benefits, Consumer savings and economic efficiency, government revenue, infrastructure development, technological innovation and competitiveness, challenges and risks.

In India, the EV sector is growing very rapidly over the years and they have many economic

policy implications. The expansion of the EV market stimulates growth in manufacturing sectors, including battery production, electric motors, and other components and it creates jobs not only in manufacturing but also in areas like Research and Development (R&D), sales, and after-sales services. Additionally, jobs in charging infrastructure development and maintenance emerge. The rise of EVs fosters the growth of small and medium enterprises (SMEs) and startups focused on innovative solutions, creating a vibrant ecosystem around EVs. The increased use of electric vehicles encourages investment in renewable energy sources, integrating solar,

wind, and other green energy into the grid and also widespread adoption of electric two-wheelers can significantly reduce India's dependence on imported oil, thereby reducing the trade deficit.

Table.8 explains the emission of pollutants in different units. The emissions intensity of electricity is set to decline further given India's plans for renewable energy. While they appear to reduce life cycle Green House Gas (GHG) emissions and eliminate all types of tailpipe pollution. EVs produce zero tailpipe emissions, leading to improved air quality and reduced health costs associated with pollution.

Table 8: Emission of Pollutants

Units (Grams/Km)	Life Cycle GHG (In CO2 eq.)	NO _x	SO _x	PM
Petrol	214	0.1	0.0004	0.003
Diesel	223	0.06	-	0.0045
EV	122	0.206	0.506	0.049

Source: www.dieselnet.com ;Bharat Stage VI Emission Standards.

Note: Four Pollutants: CO₂ - Carbon Dioxide; NO_x - Nitrogen Oxides; SO_x -Sulphur Oxides; PM - Particulate Matter.

Lower GHG emissions from the transport sector contribute to India's climate change mitigation goals, aligning with international commitments. The GHG emissions intensity is shown on a life cycle emissions basis and not simply combustion or electricity production while emissions intensity of the other pollutants refers to only emissions during fuel use phase for petrol and diesel and electricity production phase for EV. Now a days electric two wheelers are common, especially in the middle income families because it is very much influence on consumer savings and increase the economic efficiency. Electric two-wheelers have lower operating and maintenance costs compared to internal combustion engine (ICE) vehicles, leading to savings for consumers and also savings on fuel and maintenance increase consumers' disposable income, potentially boosting consumption and stimulating other sectors of the economy.

Table. 9 illustrates the disaggregating sources of change in revenues from different sources on a per vehicle basis. An ICE vehicle generates about ₹ 874,390 across its life, which is almost equal to the estimated upfront cost of ICE vehicle inclusive of all taxes and fees. In comparison, each EV generates 85 percent less government revenue per vehicle across its useful life. Loss in excise taxes on fuel account for 67 percent of the total reduction in government revenues from EVs followed by loss from lower GST and revenue loss from income tax deduction for interest payment on EV loans which account for 16 percent and 15 percent of the total reduction. Revenues from import tariffs increase substantially relative to ICE , but as a share of change total revenues per vehicle this is a small gain (Rajagopal Deepak 2023).

Table 9: Disaggregating sources of change in revenues from different sources on a per vehicle basis

Taxes and Tariffs in INR per vehicle	ICE (₹)	Share (%)	EV (₹)	Share (%)	EV - ICE (₹)	Percentage change in EV - ICE (%)	Share of change in total change
Vehicle Tax (GST)	179,845	18	60,233	28	119,612	-67	16
Road Tax	80,000	8	59,998	28	20,002	-25	3
Excise tax on fuel	495,612	49	0	0	495,612	-100	67
Electricity tax	0	0	19,643	9	19,643	-	-3
Maintenance	107,052	11	53,526	25	53,526	50	7
GST on charging infra.	0	0	7833	4	7833		-1
Import tariffs	11,880	1	39,653	18	27,773	234	-4
Loan interest income tax deduction	0	0	108,252	-50	108,252	-	15
Total government revenues	874,390	-	132,634		741,756	-85	100
Carbon tax @ \$50/tCO ₂ e	141,547	14	83,378	39	58,169	-41	8
Total with carbon tax	1,015,936	100	216,012	100	799,925	-79	

Source: Central Board of Indirect Taxes and Customs & Petroleum Planning and Analysis Cell, Govt. of India.

Note: ICE - Internal Combustion Engine; EV - Electric Vehicle; tCO₂ e - Tonnes (t) of Carbon Dioxide (CO₂) Equivalent e.

Government incentives for EVs can stimulate market growth but also require significant financial resources. Balancing subsidies with fiscal sustainability is crucial. Over time, as EV adoption increases, there may be a shift in tax revenues from fuel taxes to electricity tariffs and other forms of revenue. The rise in EVs necessitates improvements in grid management and energy storage solutions to handle increased electricity demand efficiently and significant investments in charging infrastructure are required, leading to growth in related industries and job creation.

The push towards EVs drives innovation in battery technology, energy management systems, and vehicle design, enhancing India's global competitiveness in these technologies and developing a robust EV manufacturing base can position India as an exporter of electric two-wheelers and related technologies, contributing to economic growth. At present in the EV sector there are many challenges and risks associated with their initial cost, battery disposal and supply chain dependencies. There is a high initial cost of EVs and also less number of charging stations are the barrier of the EVs and it required strategic subsidies and financial models to ensure affordability. In order to prevent negative environmental impacts, we should concern about the battery disposal and recycling of the EVs and also the dependence on imports for critical components like lithium-ion batteries poses risks and need to develop a local supply chain is essential.

5. Conclusion

The electric vehicle (EV) landscape in India, particularly in the two-wheeler segment, has shown remarkable growth and potential for further expansion. The government's initiatives, including the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme and various subsidies, have played a significant role in promoting the adoption of EVs. The market for electric two-wheelers has seen substantial growth, with sales figures rising dramatically from 2017

to 2024. This trend indicates a strong consumer demand and a shift towards more sustainable transportation options.

The Electric Vehicles (EVs) industry has witnessed tremendous growth in recent years, with indications pointing towards further escalation in the future. Sales of EVs, particularly in the two-wheeler segment, have seen a significant increase compared to previous years. However, factors such as the high price of EVs, battery failures, limited battery life span, inadequate charging infrastructure, and consumer skepticism regarding EV longevity and safety have emerged as major constraints on sales, despite government subsidies. Market trends reveal intense competition in the two-wheeler EV segment in India, with Ola Electric leading the market by selling 62,997 EVs in Q1 2024, followed by TVS Motor iQube with 51,110 units. This underscores the substantial demand for two-wheeler EVs despite their limitations.

The economic implications of the two-wheeler electric vehicle market in India are profound, influencing various sectors and aspects of the economy. The increased use of electric two-wheelers can lead to significant cost savings for consumers, reduced dependence on imported oil, and a decrease in air pollution and greenhouse gas emissions. While there are significant benefits in terms of growth, job creation, energy security, and environmental sustainability, addressing the associated challenges will be crucial for realizing the full potential of this market. Strategic policy support, investment in infrastructure, and fostering innovation will be key to driving the sustainable growth of the two-wheeler EV market in India. Performance-wise and in terms of cost-benefit analysis, customer trends indicate a surge in the sale of two-wheeler EVs in India. The introduction of new innovations in the electric vehicle sector has heightened public expectations, driven by an environmentally conscious approach. Furthermore, the expansion of the EV market is expected to stimulate economic growth by creating jobs in manufacturing, R&D, and infrastructure

development. However, the transition also presents challenges, such as the need for extensive charging infrastructure and the initial high costs of EVs. Addressing these challenges through continued policy support and investment in technology and infrastructure will be crucial for sustaining the momentum of the EV reformation in India. The success of two-wheeler EVs reflects advancements in systems and forecasts an imminent EV revolution in India.

References

- Bansal, P., Kumar, R. R., Raj, A., Dubey, S., & Graham, D. J. (2021). Willingness to pay and attitudinal preferences of Indian consumers for electric vehicles. *Energy Economics*, 100, 105340.
- Bhosale, A. P., Sharma, S., & Mastud, S. A. (2022). Characterizing the economic competitiveness of battery electric vehicles in India. *Asian Transport Studies*, 8, 100069.
- Chakraborty, R., & Chakravarty, S. (2021). Acceptance of electric two-wheelers in India: Results from a stated choice survey. Available at SSRN 3949403.
- Chaturvedi, B. K., Nautiyal, A., Kandpal, T. C., & Yaqoot, M. (2022). Projected transition to electric vehicles in India and its impact on stakeholders. *Energy for Sustainable Development*, 66, 189-200.
- Das, P. K., & Bhat, M. Y. (2022). Global electric vehicle adoption: implementation and policy implications for India. *Environmental Science and Pollution Research*, 29(27), 40612-40622.
- Dash, A. (2023). Adapting to electric vehicles value chain in India: The MSME perspective. *Case Studies on Transport Policy*, 12, 100996.
- e - AMRIT, NITI Aayog, Government of India
- Economic Survey, Government of India
- Gujarathi, P. K., Shah, V. A., & Lokhande, M. M. (2018). Electric vehicles in India: Market analysis with consumer perspective, policies and issues. *Journal of Green Engineering*, 8(1), 17-36.
- Hema, R., & Venkatarangan, M. J. (2022). Adoption of EV: Landscape of EV and opportunities for India. *Measurement: Sensors*, 24, 100596.
- Jaiswal, D., Kaushal, V., Kant, R., & Singh, P. K. (2021). Consumer adoption intention for electric vehicles: Insights and evidence from Indian sustainable transportation. *Technological Forecasting and Social Change*, 173, 121089.
- Kumar, R., Jha, A., Damodaran, A., Bangwal, D., & Dwivedi, A. (2020). Addressing the challenges to electric vehicle adoption via sharing economy: An Indian perspective. *Management of Environmental Quality: An International Journal*, 32(1), 82-99.
- Kumar, A., & Brewster, C. Investigating Electric Vehicles Adoption in Urban Public Transport: A Socio-Technical Transition Analysis Across Cities of the Global North and South.
- Ministry of Heavy Industries, Government of India
- Pirmana, V., Alisjahbana, A. S., Yusuf, A. A., Hoekstra, R., & Tukker, A. (2023). Economic and environmental impact of electric vehicles production in Indonesia. *Clean Technologies and Environmental Policy*, 25(6), 1871-1885.
- Rajagopal, D. (2023). Implications of the energy transition for government revenues, energy imports and employment: The case of electric vehicles in India. *Energy Policy*, 175, 113466.
- Saxena, D., Sharma, S., Sharma, S., & Jindal, V. (2024). Electric Vehicles: A Catalyst for

Economic Growth in India. *Journal of Informatics Education and Research*, 4(1).

Sharma, K., Tiwari, S., Kumar, A., & Sharma, C. P. (2023). Critical review of the electric vehicle ecosystem in India. *Water and Energy International*, 66(8), 42-48.

Shah, R. V. (2022). Financial Incentives for Promotion of Electric Vehicles in India- An Analysis Using the Environmental Policy Framework. *Nature Environment and Pollution Technology*, 21(3), 1227-1234.

Singh, V., Singh, V., & Vaibhav, S. (2021). Analysis of electric vehicle trends, development and policies in India. *Case Studies on Transport Policy*, 9(3), 1180-1197.

Singh, V., Singh, V., & Vaibhav, S. (2021). Analysis of electric vehicle trends, development and policies in India. *Case Studies on Transport Policy*, 9(3), 1180-1197.

Society of Manufacturers of Electric Vehicles (SMEV),

Vahan, the Ministry of Road Transport & Highways,

Wagh, R. (2024). Charged Momentum: Electric Vehicle Surge in India's 2023 Landscape. arXiv preprint arXiv:2403.13373.

BOOK REVIEW

Enrique Alberola. (Ed.) **FISCAL POLICY IN A TURBULENT ERA**. Edward Elgar Publishing Limited. Cheltenham (UK): ISBN 978 1 03530 055 6 (cased): ISBN 978 1 03530 056 3 (eBook).

This book offers a timely examination of the evolving landscape of fiscal policy in the 21st century. It identifies the intricacies of how major crises, including the Global Financial Crisis (GFC) and the COVID-19 pandemic, have catalyzed a re-evaluation of the role of fiscal policy over the last two decades. It further suggests that this re-examination marks a departure from decades of neoliberal dominance towards a renewed appreciation for proactive government intervention. Through a meticulous analysis that bridges historical economic paradigms with contemporary challenges, Alberola and his team of contributors, delve into the complex dynamics of fiscal strategies that increasingly need to aim at mitigating economic disparities and stabilizing global markets.

The book is neatly organized into four parts, each delving into different aspects of fiscal policy. The introductory chapter by Enrique Alberola sets the stage for a comprehensive analysis of global economic shifts, and the transformative role of fiscal policy in what he terms an “ongoing turbulent era.” Alberola argues that these economic “earthquakes” have not only reshaped fiscal policy but are also driving a review of its foundational principles.

Part I of the book, titled “Fiscal Resources and the Fiscal Space”, focuses on the underpinnings of fiscal policy through an examination of debt and government revenue. It explores how low interest rates and monetary policy have reduced the burden of debt, thereby opening fiscal space for broader governmental action. A significant portion of the discussion revolves around the surge in public debt triggered by the GFC and the pandemic, reaching all-time highs in many countries. This part also addresses the crucial area of re-evaluating tax systems to adapt to a globalized economic landscape.

While tracking debt trajectories across the world, Chapter 2 discusses the significant increase in debt in Advanced Economies (AEs) following the GFC, while EMDEs exhibit more varied changes. It goes on to highlight the evolving roles of private sector lenders and multilateral institutions and the challenges posed by foreign currency-denominated debt that heighten vulnerability to currency depreciation. Through regression analysis and debt decomposition, the chapter highlights a negative correlation between debt growth and initial debt levels, suggesting that higher initial debts may lead to stronger fiscal responses to managing debt effectively. It also discusses the potential for debt reduction in high-debt scenarios and the lower likelihood of debt explosions in heavily indebted contexts, indicating a cautious fiscal policy approach.

Sovereign debt restructuring has generally been a historical and ongoing challenge as noted in Chapter 3 of the book. The chapter reviews the recurring patterns of debt crises, underscoring the significant roles played by the Paris Club and the G20 in managing these crises and the negative impacts of delayed interventions. It critically examines the evolution of mechanisms like Collective Action Clauses (CACs) and the effectiveness of recent initiatives such as the Debt Service Suspension Initiative (DSSI) and the Common Framework for Debt Treatments by the G20. The discussion further highlights the necessity of early and proactive creditor negotiations and the critical role of international organizations like the

IMF in maintaining sustainable debt levels. The chapter also touches upon the complexities of defining debt boundaries, negotiating terms, and managing relationships with diverse creditor types, including the growing influence of Chinese lenders. Despite these efforts, the chapter points out ongoing transparency and equity issues in the global debt architecture and suggests reforms to enhance the effectiveness and fairness of debt restructuring processes including the potential role of the Global Sovereign Debt Roundtable (GSDR) in enhancing transparency and cooperation among all stakeholders.

There exists a complex relationship between the ongoing decline in natural interest rates and its impact on monetary and fiscal policy, as suggested by Chapter 4. The chapter identifies demographic shifts, decreased productivity, and increased demand for safe assets as key factors driving this persistent reduction in interest rates across both advanced and emerging markets, suggesting this trend will likely continue due to its structural basis. It then discusses the operational challenges faced by central banks, including managing near-zero lower-bound interest rates and relying more on unconventional measures like quantitative easing. The chapter also explores how low rates have created fiscal opportunities while complicating the roles of monetary and fiscal policy, especially during economic crises. Acknowledging the stabilizing role of low interest rates, it notes potential complications arising from the entwined monetary-fiscal dynamics and discusses how recent economic shocks such as the COVID-19 pandemic have reintroduced inflationary pressures, possibly necessitating sustained higher real interest rates.

Chapter 5, titled “A Macroeconomic Perspective on the Challenges of Taxing Multinationals” addresses complex issues surrounding the taxation of multinational corporations in a dynamic global digital economy. It discusses key problems including tax competition, profit shifting, and the allocation of taxing rights. These issues are critical given the significant economic impact of multinationals, whose revenues can exceed the GDP of large economies like the US. The chapter focuses on how multinationals use gaps in international tax rules to shift profits to lower-tax jurisdictions. It evaluates the OECD’s Inclusive Framework’s recent two-pillar solution aimed at addressing these challenges: Pillar One reallocates profits to ensure taxation aligns with economic activity and value creation, while Pillar Two introduces a global minimum corporate tax rate of 15% to curb tax competition and profit shifting. Although these reforms represent progress, the chapter notes their limitations due to exemptions and the narrow scope of businesses affected, urging stronger international cooperation to support developing countries adversely affected by current tax structures.

Part II, shifts focus to the stabilizing role of fiscal policy, analyzing its effectiveness and the critical role of fiscal rules in maintaining economic stability. It is aptly titled “Uses of Fiscal Policy: The Stabilization Role of Fiscal Policy”. This section argues that despite the traditional skepticism towards discretionary fiscal policy, recent economic crises have shown the effectiveness of decisive fiscal interventions, especially in contexts where monetary policy reaches its limits, such as the zero lower bound. This part examines how fiscal actions can either mitigate or exacerbate financial volatility.

The understanding of fiscal policy has changed over time. Shocks such as the GFC and COVID-19 pandemic have strengthened the belief that fiscal expansion can stabilize expectations, contain damage due to economic slowdown and that fiscal multipliers work well to offset the effect of higher public debt. Any possible negative spillovers of fiscal expansion are now being contained through tight, legally

enforceable fiscal rules, which ensure fiscal discipline by the government and prevent them from going overboard with expansion in the interest of higher economic growth. This is effectively brought out in Chapter 6.

Chapter 7 goes on to review how fiscal rules have performed and questions if they are the panacea which can solve all problems associated with fiscal expansion. No rule can be effective without it being designed and enforced appropriately. The authors suggest what good fiscal rules should look like. These can be identified as putting in place thresholds to the debt levels and having mechanisms to improve compliance through fiscal councils and medium-term credible fiscal frameworks. There is also a need to allow governments leeway to be able to ensure expenditures which lead to economic growth through productive public investments.

As an example, Chapter 8 explores the complexities of fiscal integration within the European Union (EU). The chapter points out that the reluctance of member countries to transfer fiscal sovereignty is a significant barrier, leading to the EU's central budget being minimal at about 1% of its GDP. The chapter also addresses the transformative impact of the COVID-19 pandemic, which prompted a critical reform of the EU fiscal framework. This shift indicates a potential change in how fiscal integration could evolve, suggesting a move towards more centralized fiscal strategies to better manage economic crises and enhance fiscal stability.

With the unfolding of the GFC in 2008, policymakers around the globe tightened prudential regulations and supervision. Fiscal policy has an important role in the midst of such financial crises. To reduce the financial stability risks a number of policy suggestions have been made. Firstly, there is a need for adequate fiscal buffers, i.e., having fiscal space proportionate to the size and features of the financial system. Secondly, there is a need to ensure that prudential regulations better reflect banks' sovereign risk exposures. Chapter 9 presents these arguments effectively.

Fiscal policy is also an instrument for redistribution, allocation and emerging demands. Inequality is of various kinds. However, the most pervasive and hard to handle for any policymaking is income inequality. According to the World Inequality Report, 2022, the richest 10% of the global population currently takes 52% of global income, whereas the poorest half of the population earns 8.5% of it. As regards global wealth inequalities, the poorest half of the global population possess just 2% of the total global assets, while the richest 10% own 76% of all wealth. Governments around the world are extensively using fiscal policies to reshape income distributions. Levels and scope of direct and indirect taxes, subsidies, pensions, and other direct transfers, as well as public spending on social services such as education and health, all have a bearing on the level of consumption expenditure of households and overall well-being. With these efforts of the Governments, inequality measures indicate improving trends across nations. Part III of the book dwells on this important aspect of fiscal policy.

In the present economic scenario, geopolitical conflicts and health crises- all bundled together, have caused an upheaval in the social milieu around the world. The gains achieved in meeting the SDG targets have seen a setback. According to the UN's preliminary assessment of about 140 targets show that only about 12% are on track; about half of them are moderately or severely off track and some 30% have either

seen no movement or regressed below the 2015 baseline. Other issues plaguing the global economy are climate change and population ageing. Can fiscal policy play a role in handling these issues? In the backdrop of economic recession, which somewhat weakens the automatic stabilizers, to improve the redistribution and effectiveness of fiscal policies, there is a need for better targeting and more resources to more vulnerable populations and taking advantage of digital technologies.

Chapter 10 investigates the effectiveness of fiscal policy in redistributing wealth. The chapter observes that while global inequality has declined, within-country inequality has risen, particularly in AEs, where income disparities are widening. Conversely, emerging markets and developing economies (EMDEs) showed a reduction in inequality until the pandemic disrupted this trend. The authors suggest that fiscal consolidation might create space for more effective redistributive policies but caution that such measures could also suppress economic activity, further complicating efforts to address inequality.

Extending the discussion, Chapter 11 goes on to examine how fiscal policy's effectiveness is impacted by economic fluctuations. The authors explain how the interplay between deep recessions and expansions has led to a "ratchet effect" where inequality and public debt increase, exacerbated by weaker automatic stabilizers. They argue that reduced fiscal progressivity has not only amplified income inequality but also led to higher public debt levels, contrary to what might be expected. The weakening of automatic stabilizers, according to the authors, necessitates a greater reliance on discretionary fiscal measures to manage economic cycles effectively.

With the world rapidly ageing, greying is a challenge for public finance and fiscal policy. This aspect is examined in Chapter 12. Ageing would mean increased expenditure on pensions, health and long-term care. An increased dependency ratio also means decreasing revenues. If the gap between spending and revenue increases, fiscal sustainability is threatened. Pension reforms are required to make pensions sustainable going forward.

The concluding Chapter 14 synthesizes the discussions from previous sections and contemplates the future trajectory of fiscal policy. This chapter critically examines the interplay of fiscal policy within macroeconomic theory and practice, discussing traditional concerns such as the impact of government deficits on private savings and the risk of public debt crowding out private investment. The discussion uses a general equilibrium model to illustrate the effects of low interest rates influenced by government deficits on private capital accumulation. It further explores the historical relationship between fiscal and monetary policies, highlighting how changes in interest rates have shaped fiscal policy effectiveness, particularly when interest rates are near their lower bound. The analysis suggests significant Keynesian complementarities between fiscal and monetary policies, especially during periods of low interest rates, which have become more common in recent economic history. In the last 15 years, referred to as the "turbulent era," the authors argue that fiscal policy has increasingly assumed the role of financier of last resort, which has been crucial in mitigating the economic impacts of the pandemic and enhancing financial stability. However, they caution that this expanded role necessitates high fiscal credibility and adequate policy space to be effective.

¹ <https://hlpf.un.org/sites/default/files/2023-04/SDG%20Progress%20Report%20Special%20Edition.pdf>

The list of uncertainties that policy makers need to factor in while making any policy in these times is only getting longer, deeper and more problematic. A new normal with a set of new uncertainties needs to be dealt with through new innovative ways. “Fiscal Policy in a Turbulent Era” stands out as a compelling piece of scholarly work that provides insightful analyses and discussions relevant to both academia and policy-makers in these uncertain times. It provides a fresh perspective on the interconnections between fiscal and monetary policy in a nuanced economic context and provides a robust framework for thinking about the role of fiscal policy in economic resilience and stability. Its global perspective ensures that it is relevant to a diverse audience, be it those engaged in shaping economic policies or studying economic policy at an advanced level. It comprehensively explores multiple dimensions of fiscal policy - from the underpinnings of fiscal space and public debt dynamics to the nuances of fiscal governance and the pivotal role of fiscal policy in addressing inequality and supporting environmental sustainability.

While the book comprehensively explores the subject it covers, there are some areas where it could potentially expand its horizon to offer a deeper exploration of fiscal policy challenges. Firstly, while the analysis is backed by empirical rigor, there is scope for further exploring nonlinear relationships and dynamic effects within debt dynamics. Secondly, the discussion on the effectiveness of policy responses to debt crises would benefit from a more critical evaluation of the long-term sustainability and practical applicability of debt reduction strategies, especially in EMDEs. Expanding the range of case studies could deepen this analysis. Thirdly, the interplay between fiscal and monetary policies in a low-interest-rate environment is well articulated. However, adding a forward-looking perspective to examine potential shifts in these relationships amid changing global economic dynamics would add value. Finally, a more detailed examination of the practical implications of the book’s policy recommendations, including the feasibility and risks associated with these policies in today’s economic situation, would provide a practical viewpoint for their implementation. Enhancing these areas would significantly increase the book’s value to policymakers, academics, and other interested readers.

Dr K.P. Krishnan

Former Honorary Research Professor

Centre for Policy Research

New Delhi

SUBMISSION GUIDELINES TO AUTHORS

Aarthika Charche – FPI Journal of Economics & Governance is a bi-annual journal published by Fiscal Policy Institute, Government of Karnataka, Bengaluru (India). The Journal invites original and unpublished research articles on Indian economy and economic governance at national, state and local levels. Articles focusing on macroeconomics, public finance, fiscal policy, financial decentralization, public financial management, public project management and evaluation, Child Budget, Gender Budget and audit and e-Governance with special reference to Karnataka State are of special importance for the Journal.

Manuscript for consideration for publication shall be sent (a) in duplicate and by post to the Director, Fiscal Policy Institute, Bangalore-Mysore Road, Kengeri Post, Bengaluru 560060, India; or (b) by email attachment to: director[at]fpibangalore[dot]gov[dot]in and journal [at]fpibangalore[dot]gov[dot]in

Guidelines for preparation of manuscripts

Title Page

Title page shall contain title of manuscript, name of author(s) including their position, affiliation and contact details (postal address, telephone number and email), abstract of article (less than 250 words), JEL Classification Codes (<https://www.aeaweb.org/jel/guide/jel.php>), and acknowledgments, if any.

Declaration & Disclosure

On a separate page, author/s should declare that the article is 1) the original work of the author/s, 2) not published earlier and 3) not under consideration for publication elsewhere. In case of more than one author, the corresponding author should confirm that all the co-authors have given their consent to contents of the manuscript.

Corresponding author acts on behalf of all co-authors and ensures that questions related to the accuracy of any part of the work are appropriately addressed.

Author(s) should disclose any sources of funding that have supported the research work in the article and also declare whether they have obtained prior permission from the funding agency to publish the article.

Text

Text to be in MS word document format. Times New Roman font with 12 size, 1.5 line spacing and justified alignment. Page margin (left, right, top and bottom) to be one-inch (2.54 centimetres – normal margins).

Headings and sub-headings to be in lower case (Sentence case) and bold. Headings and sub-headings to be numbered (e.g. if a heading number is 1, its sub-headings to be up to two levels: 1.1 and 1.1.1).

All tables and figures to be in editable format and placed in running text. All tables and figures to be numbered sequentially. Title (or caption) of a table/figures to be on top and notes and sources to be at bottom.

All equations to be sequentially numbered and inserted in text using equation editor.

Abbreviations to be defined at first mention and used consistently thereafter.

All notes to be footnotes to be given at the bottom of the page. (All notes in the text to be given in the form of footnotes at the bottom of the page). No footnote to include any tables, figures and reference list. All footnotes to be in Times New Roman font with 10 size, 1 line spacing and justified alignment.

All annexures to be given at end of text.

References

Please follow the reference style of American Psychological Association (APA) 6th Edition. <https://www.lse.ac.uk/gender/assets/documents/apa-6th-style-for-referencing.pdf> (The list of reference to include those cited in text, footnotes, tables, figures and annexures).

Size of the Manuscript

The preferred size of manuscript (including references, tables, figures and annexures) is 5000 to 7000 words.

Others

Capital letter to be used for: Constitution, Government of India, Union/Central Government, Government of Karnataka, Central Finance Commission, State Finance Commission, and Centrally Sponsored Scheme.

Editorial Review process

All submitted manuscripts undergo a preliminary review by the editor-in-chief and those found suitable for the Journal are reviewed by experts by a double blind review process. Manuscripts are acceptable for publication subject to (a) reviewer's recommendation for publication and (b) author(s)' satisfactory revision based on reviewers' comments and suggestions, if any. However, the editors reserve the right to accept or reject an article for publication.

All accepted manuscripts are copy edited and sent for authors' approval. Print page proofs are read by the authors, or by the Journal' editorial team to avoid delay in communication and speed up publication. Print and soft copies of Journal's issues are sent to all authors.

Vision & Mission of Fiscal Policy Institute

Vision:

The resources invested through FPI enhance quality of human capital engaged in public service delivery, the outcome of which enhances their efficiency, promotes a habit of adherence to macro-prudential fiscal norms and ensures value for money to citizens for all time.

Mission:

The mission of FPI is 'to position itself as the first point of reference for consultancy and hand holding by all the public sector administrative units by imbibing the sense of fiscal responsibility and by infusing the matching practices w.r.t the legislative objective of the Fiscal Responsibility and Budget Management Act of 2003 as also the Fiscal Responsibility and Budget Act of 2003 as the Karnataka Fiscal Responsibility Act,2002, more particularly in line with the fiscal management principles enunciated under Sec 4 of KFRA up to Taluka level by 2015, and thereafter efficiently continue those operations all the time' while converting itself into a profit centre by 2016 by providing its services and outputs at reasonable and affordable costs to users and the government.

Submission of Article

FPI welcomes contributions in the form of original articles on current issues and topics; evaluation of relevant programs, projects and policies; literature reviews (of recently published / seminal books in the field); and perspective on how the field should and will develop in the future. For further details please visit www.fpi Bengaluru.karnataka.gov.in (refer to Submission guidelines for Authors at the end of this edition)

Subscription Information

The soft copy of the journal is available on the website www.fpi Bengaluru.karnataka.gov.in

Copyright

All material published in this journal is protected by copyright, which covers exclusive rights to reproduce and distribute the material.

Editorial and Administrative Address

Fiscal Policy Institute, Kengeri Post, Bengaluru-Mysuru Road, Bengaluru - 560060
Telephone : +91 80 26971000 Fax : +91 80 26971010 e-Mail director@fpibangalore.gov.in

Printed and Published by Dr Vishal R, Director, Fiscal Policy Institute on behalf of Fiscal Policy Institute,
Kengeri Post, Bengaluru-Mysuru Road, Bengaluru - 560060.

Printed at Paramount Color Graphics Rajajinagar, Bengaluru - 10.



ಭಾರತ 2023 INDIA
ವಸುದೈವ ಕುಟುಂಬಕಂ
ಒಂದು ಭೂಮಿ, ಒಂದು ಕುಟುಂಬ, ಒಂದು ಭವಿಷ್ಯ

GOVERNMENT OF KARNATAKA

ಕರ್ನಾಟಕ ಸರ್ಕಾರ

ANNUAL FINANCIAL STATEMENT (BUDGET)

FOR THE YEAR 1974-75



(As presented to the Legislature in March 1974)

(1974ನೆಯ ಇಸವಿ ಮಾರ್ಚ್ ತಿಂಗಳಲ್ಲಿ ವಿಧಾನ ಮಂಡಲದ ಮುಂದೆ ಮಂಡಿಸಿದಂತೆ)



Government of Karnataka
FISCAL POLICY INSTITUTE



Kengeri Post, Bengaluru-Mysuru Road, Bengaluru - 560060
Telephone : +91 80 26971000 Fax : +91 80 26971010 e-Mail director@fpibangalore.gov.in