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Editor's Desk

It's my pleasure to introduce this recent issue of Journal of Economic and Policy Research to our readers. I intended to write a few lines on India's G-20 presidency as it is recognized as voice of global south at the summit stimulating the discussions on various economic issues at global platform. With the advent of the G-20 Summit, there is lot of enthusiasm and hype among scholars to envision the credibility of India's G-20 presidency in shaping up the global agenda while promoting its priorities. The world watches with hope and optimism as India appeared triumphant over the years due to its strong commitments in stabilizing its economy particularly in achieving financial stability. India can be a game changer in bringing financial stability and security to the debt-ridden economies. Recalling American deputy national security adviser who described "India as very high on America's list of partners that can truly help move forward a global agenda," India's supremacy depends on how closely the other partners support economic and diplomatic relations with the former against the present rapidly changing geopolitical scenario. Political harmony among G-20 nations propels inclusive growth, harnesses the efforts in achieving financial inclusion.

As a G-20 leader, India would face challenges and issues, at this moment, a strategic move giving weightage to the divergent views and differing visions of others, uphold the county's diplomatic finesse in the world. India can be a unifying force in the deliberations and discussions with G-20 nations in bringing robust financial regulatory framework, building strong banking systems in G-20 nations, and enhancing digital financial inclusion.

The current issue compiles papers on varied themes viz., public debt, interlinkages between Indian currency and macroeconomic factors, financial literacy and behavioral biases of stock market investors and agrarian communities and climate change vulnerability analysis, making the readers enjoy on the highly topical research areas of interest, that deserve special discussions at global platform – G-20 Summits.

I thank all the writers for their contribution to the journal.

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Dr Usha Nori

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Public Debt of Kerala State and Related Risk Analysis: An Econometric Study

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Abstract

The growing fiscal obligations of Kerala are increasingly met from debt liabilities. This has led to a significant increase in the market borrowings of the state during the last decade. The increased reliance on market borrowings results in public debt accumulation and high debt servicing costs. To secure government's low-cost funding over the medium and long term while avoiding excessive risk, an assessment of public debt is crucial. This study empirically analysed the present debt profile of Kerala in terms of costs, maturity, and potential risk factors. In addition, this study determined the dynamic relationship between the public debt and economic growth of the state by using the autoregressive distributed lag (ARDL) models. Our results reveal that public debt exerts a nonlinear impact on economic growth in both the long and short run in Kerala, and this impact may be described by an inverted U-shaped relationship.

Keywords: Autoregressive Distributed Lag Models, Kerala State, Market Borrowings, Public Debt, Time Series Regression

Introduction

Public debt has increased globally in the aftermath of the global financial crisis, highlighting the importance of prudent fiscal management and debt management strategies in preventing financial shocks to the country. The level of debt has substantially increased at national and subnational levels following the severe COVID-19 pandemic. In particular, the pandemic has exerted a heavy toll on the finances of states in India. Moreover, the states borrowed substantial amounts of money from the open market to

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mitigate the effects of the pandemic. Rising public debt levels have limited the ability of governments to mobilise resources for achieving sustainable development goals. With the growth of public debt levels, governments are likely to spend more on debt servicing and less on public goods, such as health, education, and infrastructure. This study highlights the public debt of Kerala state in India and the associated risks, emphasising the relationship between public debt and economic growth.

Kerala is among the economically developed states of India and leads many other Indian states in terms of the per capita gross domestic product, poverty eradication, and human development index. Although Kerala has achieved remarkable progress in many socioeconomic development indicators, its fiscal performance has not been impressive in recent years. The fiscal space of Kerala for meeting revenue expenditure, particularly salaries, pensions, and interest payments, out of own revenue receipts is shrinking. The market borrowing of the state significantly increased during the last decade because of the high reliance on debt liabilities to meet the day-to-day obligations of the government. Thus, the analysis of public debt and debt issuance is critical for Kerala for fiscal consolidation and better debt management. Against this background, this study investigated the public debt of Kerala to determine the trade-off between costs and risks associated with public debt.

Public debt exerts a crucial effect on the economy in both short and long terms. Whether public debt is useful or harmful towards economic growth remains one of the most prevailing debates in the literature, and no consensus has been reached on this topic. This study employed econometric models to examine the long and short run effects of public debt on the economic growth of Kerala. To the best of our knowledge, this is the first state-specific study to recommend effective debt management strategies for Kerala and thus aid in transitioning it into a developed economy. The paper initially discusses a detailed literature on the microstructure of subnational public debt and the impact of public debt on economic growth; provides an overview of Kerala state finances and moves on with empirical validity thus describing the data and methodology implemented. The study provides econometric framework to determine the dynamic relationship between the public debt and economic growth of Kerala and the associated risks. Finally, the paper concludes with some major findings and recommendations.

Literature Review

Few studies have analysed public debt and the associated risks for Indian state governments. However, numerous empirical studies have explored the government borrowing programme, examined the main debt-raising

channel, and identified the determinants of costs of borrowings from a cross-country perspective as well as the Indian context. Beck et al. (2017) and Bellot et al. (2017) have conducted an up-to-date literature survey on the cross-country analysis of the determinants of costs of open market borrowings. In the Indian context, Bose et al. (2011) performed panel data analysis to identify the determinants of Indian state government securities yield from 2006-07 to 2010-11. Furthermore, Rangarajan and Prasad (2013) focused on states' borrowing and debt restructuring processes underpinned by the move towards a rule-based framework and market discipline. Dey and Nair (2013) examined the effect of the deregulation of government securities market on the cost of market borrowings of major Indian states. Pandey (2016) analysed the trend of state debt as well as discussed the sources of state borrowing and problems related to state debt. Saggar et al. (2017) evaluated the spreads of government securities of all Indian states relative to those of central government securities in auctions conducted during 2015-16 and 2016-17. Kanungo (2018) provided detailed insights into state government borrowings and problems pertaining to risk asymmetries across states in the borrowing cost. Nath et al. (2019) reviewed the existing literature on the determinants of sub-sovereign bond yield spreads and examined the yield spreads of 22 Indian state governments by using a panel data framework. In addition, they developed a model for the efficient valuation of nontraded state securities in the Indian securities market. Jangili et al. (2022) developed a composite index of states' fiscal performance and determined whether the constructed index can explain the yield spread of state government securities.

Dholakia et al. (2004), Goyal et al. (2004), Rajaraman et al. (2005), Nayak and Rath (2009), Misra and Khundrakpam (2009), Makin and Arora (2012), and Dasgupta et al. (2012) have addressed fiscal deficits and their implications for public debt sustainability at the sub-national level in India. However, most of these studies have focused only on sub-national debts at the consolidated level. Kaur et al. (2018) and Misra et al. (2023) have conducted an up-to-date literature survey on the debt sustainability of sub-nationals in India.

Numerous studies have investigated the impact of public debt on economic growth both for a panel of multiple countries and individual countries. However, most of the studies have investigated the nonlinear relationship between public debt and growth nexus and estimated the threshold of public debt share to gross domestic product (GDP) (See Smyth and Hsing, 1995; Blavvy, 2006; Reinhart and Rogoff, 2010; Cecchetti et al., 2011; Reinhart et al., 2012; Checherita-Westphal and Rother, 2012; Furceri and Zdzienicka, 2012; Herndon et al., 2013; Woo and Kumar, 2015; Chen et al., 2017). In addition, many studies have examined the linear relationship

between public debt and economic growth and problems related to debt sustainability from the Indian context (Singh, 1999; Rangarajan and Srivastava, 2005; Kannan and Singh, 2007; Goyal, 2011; Bal and Rath, 2014; Barik and Sahu, 2022). However, no study has evaluated the impact of public debt on economic growth at the sub-national level in India. This paper attempts to fill this research gap. The major contributions of this study are two-fold. First, we analysed costs and risks associated with the public debt of Kerala state to better understand the trade-off between costs and risks associated with outstanding debt. Second, we examined the nonlinear relationship between public debt and economic growth in Kerala to determine the turning point or threshold of public debt above which the public debt exerts an inverse effect on economic growth.

Overview of Kerala State Finances

Following the philosophy of growth-inductive fiscal management, the Government of Kerala enacted the Fiscal Responsibility and Budget Management (FRBM) Act in 2003 to reduce the stock of debt and deficits, mainly revenue and fiscal deficits, by eliminating non-productive expenditures. Adherence to this legislation was supported by the implementation of the Debt Swap Scheme from 2002-03 to 2004-05 and the Debt Consolidation and Relief Facility from 2005-06 to 2009-10. Subsequently, each finance commission recommended curtailing the revenue deficit and restricting the fiscal deficit to 3 per cent of the gross state domestic product (GSDP). Under the fiscal consolidation path prescribed by the 13th Finance Commission, Kerala had to achieve zero revenue deficit by 2014-15 and restrict its fiscal deficit to 3 per cent of the GSDP from 2013-14 onwards.

Table-1: Profile of Kerala State Finances (Accounts as per cent of GSDP at current prices)

Item	2000-01	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Total Revenue	8.4	12.3	11.9	11.8	11.8	11.1	12.7	12.9
Own Revenue	6.3	8.4	8.2	8.2	7.9	7.7	7.1	7.6
From Centre	2.1	3.8	3.7	3.6	3.9	3.4	5.5	5.3
Total Expenditure	12.0	15.5	16.1	15.7	15.2	14.1	18.0	18.0
Revenue	11.4	14.0	14.3	14.2	14.0	12.9	16.0	16.1
Capital	0.6	1.5	1.8	1.5	1.2	1.2	2.0	1.9
Revenue Deficit	3.0	1.7	2.4	2.4	2.2	1.8	2.6	2.3
Fiscal Deficit	3.7	3.2	4.2	3.8	3.4	2.9	4.6	4.1
Interest payments	2.2	2.0	1.9	2.2	2.1	2.4	2.7	2.6
Primary Deficit	1.6	1.2	2.3	1.7	1.3	0.6	1.8	1.5
Total Debt	23.0	28.0	29.4	30.0	29.9	32.0	38.5	37.0
GSDP Growth (%)	5.0	9.6	13.0	10.5	12.4	3.1	-5.2	17.6

Source: Kerala state budget documents

The ratio of revenue receipts to GSDP of the state increased from 8.4 per cent in 2000-01 to 12.9 per cent in 2021-22 (Table-1). Although the state's own revenue increased in absolute terms, the ratio of its own revenue to GSDP declined from 8.4 per cent in 2015-16 to 7.6 per cent in 2021-22. The ratio of total expenditure to GSDP increased from 12.0 per cent to 18.0 per cent during 2000-01 to 2021-22. Furthermore, the ratio of capital expenditure to GSDP marginally increased from 0.6 per cent to 1.9 per cent during the same period. Revenue expenditure accounted for 89.6 per cent of the total expenditure, whereas capital expenditure accounted for only 10.4 per cent of the total expenditure in 2021-22. On average, interest payments grew by approximately 15 per cent each year from 2011-12 to 2021-22 because of increased dependency on debt liability. The expenditure on interest payments as a percentage of GSDP stood at 2.6 per cent in 2021-22. Because a sizeable percentage of fiscal deficit was accounted for by revenue deficit, the fiscal deficit has consistently risen over the years. The ratio of the outstanding debt to GSDP increased from 23.0 per cent in 2000-01 to 37.0 per cent in 2021-22.

Data and Methodology

This section discusses the data and methodological framework adopted for the empirical analysis of the public debt of Kerala and the related risks, including the dynamic relationship between public debt and economic growth in Kerala.

Data

The main sources of data were 'State Budget Documents' for various years published by the Government of Kerala and 'State Finances: A Study of Budgets' and 'Handbook of Statistics on Indian States' for various years published by the Reserve Bank of India (RBI). The time series statistics on Kerala state finances, market borrowing program, and outstanding public debt were compiled from information provided in the aforementioned publications. Data on GSDP were obtained from the State Economics and Statistics Department of Kerala. The econometric analysis performed in this study covered the sample period from 1982-83 to 2021-22.

Methodology

In this subsection, we describe the theory underlying debt dynamics and risk measures, the outline of the econometric approach, and the specification of the model used in this study.

Debt Dynamics

Debt dynamics can be expressed in terms of the government's intertemporal budget constraint. Debt is sustainable if the intertemporal solvency condition is satisfied, where the expected present value of the

future primary balances covers the existing stock of debt. Building on the debt evolution formula and assuming for simplicity that there is no foreign currency denominated debt:

$$E_t + i_t D_{t-1} - R_t = D_t - D_{t-1} \quad ...(1)$$

where E_t is the government's primary expenditure, R_t is the government revenues and D_t is the stock of debt at time t.

The primary balance at time t, $PB_t = R_t - E_t$.

The substitution of PB_t in (1) provide us with an evolution of debt formula:

$$D_t = \left(1 + i_t\right) D_{t-1} - PB_t \quad ...(2)$$

where $\left(1 + i_t\right)$ equals nominal interest rate at time t.

Then the intertemporal budget constraint for $t = N$

$$D_N = \left(1 + i\right)^N D_0 - \sum_{j=1}^{N} \left(1 + i\right)^{N-j} PB_j \quad ...(3)$$

To obtain the solvency condition, divide both sides of (3) by $\left(1 + i\right)^N$ and solving for D_0:

$$D_0 = \sum_{j=1}^{N} \left(\frac{1}{1+i}\right)^j PB_j + \left(\frac{1}{1+i}\right)^N D_N . \quad ...(4)$$

Then, take the limit as $N \to \infty$ and impose the transversality (No-Ponzi scheme) condition:

$$\lim_{N \to \infty} \left(\frac{1}{1+i}\right)^N D_N = 0$$

Then, the solvency condition becomes,

$$D_0 = \sum_{j=0}^{\infty} \left(\frac{1}{1+i}\right)^j PB_j \quad ...(5)$$

If the transversality holds, the outstanding initial debt should be covered by the present value of future primary balances.

Further, the primary balance at time t, $PB_t = E_t - R_t$.

Hence, $D_t = (1+i_t) D_{t-1} + PB_t$ ...(6)

Dividing both sides of (6) by Gross Domestic Product (GDP), Y_t

$$\frac{D_t}{Y_t} = (1+i_t)\frac{D_{t-1}}{Y_t} + \frac{PB_t}{Y_t}$$

$$\frac{D_t}{Y_t} = (1+i_t)\left(\frac{D_{t-1}}{Y_{t-1}}\right)\left(\frac{Y_{t-1}}{Y_t}\right) + \frac{PB_t}{Y_t}$$

Then, $d_t = (1+i_t) d_{t-1}\left(\frac{Y_{t-1}}{Y_t}\right) + pb_t$

Therefore, $d_t = \frac{(1+i_t)}{(1+G_t)} d_{t-1} + pb_t$ ...(7)

where G_t is the GDP growth, defined as $G_t = \frac{Y_t - Y_{t-1}}{Y_{t-1}}$.

The fiscal policy is unsustainable when $G_t = i_t$ or $G_t < i_t$; because d_t grows linearly when $G_t = i_t$ and explosively when $G_t < i_t$. Debt is sustainable when $G_t > i_t$. The last condition is considered as a necessary condition for sustainability, based on the assumption that the faster income grows, the lighter will be the burden on debt.

Risk Measures

The price (P) of a security with face value 100, annual coupon rate C, number of coupon payment remaining n, frequency of coupon payment f (1 for annual, 2 for half-yearly, etc.) and annual yield-to-maturity y can be expressed as the sum of the present values of future cash flows as follows:

$$P = \sum_{j=1}^{n} \frac{C/f}{(1+y/f)^{w+j-1}} + \frac{100}{(1+y/f)^{w+n-1}} \quad ...(8)$$

where $w\ (0 < w \le 1)$ represents the ratio of the number of days from the settlement date to the next coupon date to the number of days in the coupon period in which the settlement date falls.

The weighted average coupon and weighted average maturity of outstanding government securities are conventional risk measures that represent the debt servicing cost and refinancing risk of the government.

The weighted average coupon (the weight is the amount outstanding of individual securities) of an outstanding stock of securities represents the average interest costs of market loans to the government. The higher the weighted average cost, the higher the debt servicing cost to the government and it will squeeze government budgets. Similarly, the weighted average maturity (the weight is the amount outstanding of individual securities) is the average residual time to maturity of debt instruments that make up the debt. A longer weighted average maturity indicates that debt instruments are rolled over less frequently, and therefore, there is a lower refinancing risk and less uncertainty regarding future debt cost.

Duration and convexity are simple tools for measuring the interest rate sensitivity of a security (Srimany and Gayen, 2009). The duration of a security is a linear approximation of its price change after a small change in its yield. The longer the duration of a security – measured in years – the more interest rate-sensitive it is. Since the price-yield relationship for securities is not linear but convex, a measure of convexity is also used to account for small changes in yields. Convexity is a second-order effect that describes how duration changes as yield changes. Mathematically, the duration/convexity method uses a Taylor expansion to approximate the relative change in government securities price dP / P, following a small change in the yields of government securities dy. D^* and C^* denote the modified duration and convexity of government securities, respectively.

$$\frac{dP}{P} = -D^* dy + \frac{1}{2} C^* (dy)^2 \qquad ...(9)$$

$$\text{where } D^* = -\left(\frac{1}{P}\right)\frac{dP}{dy} \text{ and } C^* = -\frac{dD^*}{dy}. \qquad ...(10)$$

Time Series Regression Framework

To investigate the nonlinear effect on the relationship between government debt and growth nexus in Kerala, we used a simple linear model describing the link between economic growth and public debt while controlling for other growth determinants. According to previous studies, this model takes the form of a neo-classical growth regression equation augmented with the government debt variable:

$$G_t = \beta_0 + \beta_1 D_t + \varepsilon_t, \qquad ...(11)$$

where G_t is the annual real GSDP growth rate and D_t is the ratio of debt to GSDP. β_0 and β_1 are regression coefficients, and $\{\varepsilon_t\}$ is an independent and identically distributed error term with zero mean and constant variance.

Because this study determines whether a nonlinear relationship exists between government debt and economic growth, the following model

specification that accounts for the polynomial trend of the debt variable is considered.

$$G_t = \beta_0 + \beta_1 D_t + \beta_2 D_t^2 + \varepsilon_t , \qquad ...(12)$$

In this equation, a squared term of debt, D_t^2, is introduced as an additional regressor to capture the nonlinear relationship between economic growth and public debt.

To estimate long- and short-run dynamics between the variables of interest in equation (12), we adopted the autoregressive distributed lag (ARDL) bound testing approach to cointegration developed by Pesaran, Shin, and Smith (2001). Equations (11) and (12) are reformulated into a combined ARDL and quadratic polynomial function framework as follows:

$$\Delta G_t = \beta_0 + \beta_1 G_{t-1} + \beta_2 D_{t-1} + \sum_{i=1}^{p} \eta_i \Delta G_{t-i} + \sum_{i=1}^{q} \theta_i \Delta D_{t-i} + \varepsilon_t , \qquad ...(13)$$

and

$$\Delta G_t = \beta_0 + \beta_1 G_{t-1} + \beta_2 D_{t-1} + \beta_3 D_{t-1}^2 + \sum_{i=1}^{p} \eta_i \Delta G_{t-i} + \sum_{i=1}^{q} \theta_i \Delta D_{t-i} + \sum_{i=1}^{r} \delta_i \Delta D_{t-i}^2 + \varepsilon_t \qquad ...(14)$$

where $\beta_i, i = 1,2,3$ are long-term parameters; η_i, θ_i, and δ_i's are short-term parameters; and p, q, and r represent the number of lags of the first differentiated variable.

In the ARDL framework, the test for determining the presence of a cointegration relationship between variables was performed by testing the joint significance of lagged-level variables $\left(G_{t-1}, D_{t-1}, D_{t-1}^2\right)$ in equation (14) by conducting the Wald coefficient restriction test (*F* test). The null hypothesis of no cointegration is $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$ against the alternative $H_1 : \beta_1 = \beta_2 = \beta_3 \neq 0$. A significant *F* test statistic for testing the joint significance of lagged-level variables indicated the existence of a long-term relationship. According to equation (14), the long-term parameters capturing the long-term effects of explanatory variables on the dependent variable are normalised on β_1 and calculated as $\gamma_0 = -\beta_0 / \beta_1$; $\gamma_2 = -\beta_2 / \beta_1$; and $\gamma_3 = -\beta_3 / \beta_1$. The model with long-term coefficients is derived as follows:

$$G_t = \gamma_0 + \gamma_2 D_t + \gamma_3 D_t^2 + \upsilon_t . \qquad ...(15)$$

Once the long-term relationship is established between the dependent and explanatory variables, the short-term impact of independent variables can be estimated using the corresponding ARDL error correction model:

$$\Delta G_t = \beta_0 + \sum_{i=1}^{p} \eta_i \Delta G_{t-i} + \sum_{i=1}^{q} \theta_i \Delta D_{t-i} + \sum_{i=1}^{r} \delta_i \Delta D_{t-i}^2 + \mu ECM_{t-1} + \varepsilon_t, \quad \ldots(16)$$

where μ is the coefficient of the error correction term, which measures the speed of adjustment of the model towards the long run equilibrium. Its value is expected to be negative and lie in the interval (-1, 0).

To determine whether a nonlinear relationship exists between public debt and economic growth, equation (15) is used and the coefficients of linear and quadratic debt terms are calculated. If the coefficients of linear and quadratic debt terms, that is γ_2 and γ_3, are significantly different from zero, then a nonlinear relationship exists between public debt and growth; the nature of nonlinearity is determined by the signs of the two coefficients. If γ_2 is negative and γ_3 is positive, the relationship between the two variables follows a U-shaped pattern. If γ_2 is positive and γ_3 is negative, an inverted U-shaped relationship exists between the two variables.

To calculate the critical point corresponding to the growth-enhancing debt level, the first-order partial derivative of equation (15) is computed with respect to D_t and is set to zero. Thus, the critical point of public debt above which the marginal impact of debt becomes negative is obtained as $D_t^* = -\gamma_2 / 2\gamma_3$. The aforementioned specification follows works by Blake (2015); Sanusi, Hassan and Meyer (2019); Bhatta and Mishra (2020); and Rutayisire (2021) who employ the same methodology combining the ARDL bound testing approach to cointegration and the quadratic polynomial function to investigate the nonlinear effects of public debt on economic growth.

Empirical Results and Discussion

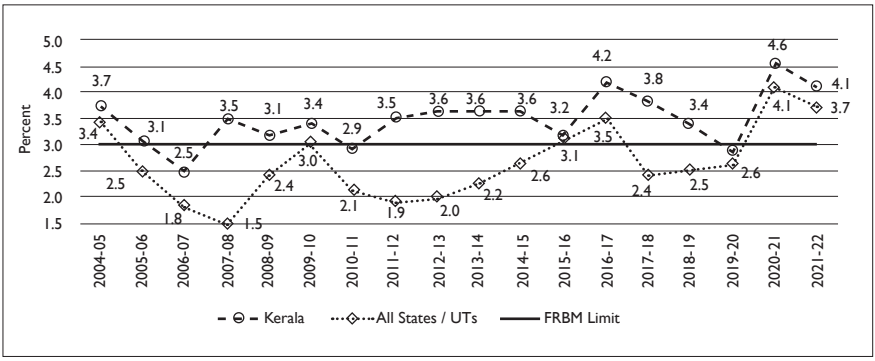
This section discusses the public debt of Kerala state to better understand the dynamics of costs and the associated risks.

Trend in Gross Fiscal Deficit

The fiscal position of state governments in terms of gross fiscal deficit (GFD) significantly improved after the implementation of fiscal rules through the enactment of the state's fiscal responsibility legislation (FRL). However, because the Kerala Fiscal Responsibility Act 2003 mandated that the state should maintain the fiscal deficit to 3 per cent of GSDP by 2017-18, Kerala still has to manage its finances to reach the prescribed limit. To provide a historical perspective of the fiscal position of Kerala, Figure-1 compares GFD as a percentage of GSDP (GFD/GSDP) of Kerala with all states and union territories (UTs) together for the period from

2004-05 to 2021-22. The GFD/GSDP ratio of Kerala remained above the FRBM limit, except for a few years after the implementation of the FRBM Act 2003. The GFD increased to 4.6 per cent of GSDP in 2020-21, which was the highest since 2004-05; this increase resulted from a shortfall in revenue receipts and higher revenue expenditure on healthcare and other social services due to the COVID-19 pandemic. Furthermore, in 2021-22, the fiscal deficit level decreased to 4.1 per cent of GSDP.

Figure-1: GFD/GSDP ratio of Kerala state



The deficits and debts of Indian states have been rising, resulting in rapid growth in states' market borrowings, which are increasingly becoming comparable to those of the central government (Saggar *et al*., 2017). Even with the rising combined deficits of states, open market borrowing has remained the predominant source of financing. Table-2 depicts the financing pattern of Kerala's fiscal deficit. In terms of the sources of financing, over the years, the share of special securities issued to national small savings fund (NSSF) in financing the fiscal deficit has significantly decreased and the dependency on market borrowings and provident funds has increased.

Table-2: Composition financing the fiscal deficit of Kerala (in per cent)

Item	2004-05	2017-18	2018-19	2019-20	2020-21	2021-22
Market Borrowings	30.9	60.4	51.9	52.9	65.5	48.6
Loans from Centre	-1.0	-0.5	-0.9	6.0	1.5	-0.1
Special Securities issued to NSSF	58.9	3.9	3.9	7.5	6.9	7.3
Loans from NABARD, LIC etc.	8.9	-0.1	-0.6	0.2	-0.3	-0.3
Provident Funds	13.3	26.9	35.7	34.7	32.8	49.4
Reserve Funds	2.8	0.7	6.8	-6.4	0.5	-0.7
Deposits and Advances	-1.8	1.0	1.5	2.2	1.4	4.8
Suspense and Miscellaneous	2.2	4.5	-2.8	-0.3	-6.2	-7.0
Remittances	0.5	-0.6	-0.2	0.5	0.1	-1.2
Others	-14.7	3.8	4.8	2.5	-2.3	-0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0

'Others' include loans from other institutions, compensation bonds, appropriation to contingency fund, inter-state settlement, contingency fund and draw-down of cash balance.

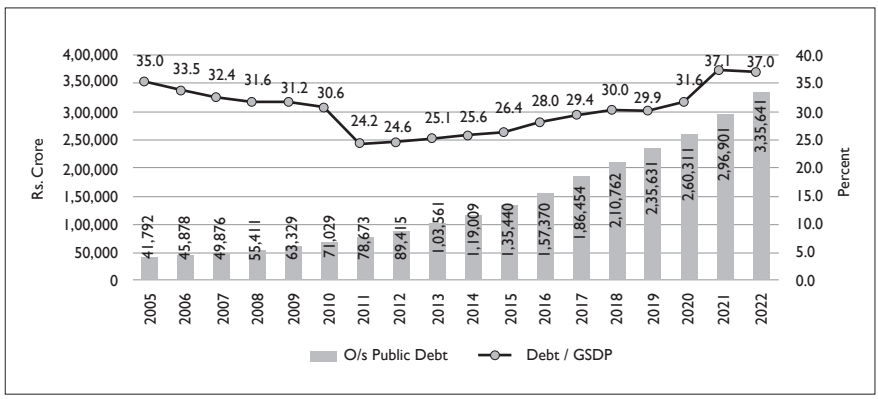
Source: State Finances: A Study of Budgets and Kerala State Budget Documents

The proportion of market borrowing in financing reached a peak level of 65.5 per cent for Kerala in 2020-21 from approximately 31 per cent in 2004-05. Furthermore, in 2021-22, the share of market borrowings in financing the deficit decreased to 48.6 per cent and the share of provident funds increased to manage the reduction in market borrowings. The change in composition helped in reducing the burden of interest payments and is a movement towards fiscal consolidation through interest rates determined by the market.

Profile of Public Debt in Kerala

The FRBM Review Committee (2017) suggested a ceiling of 60 per cent of GDP for general government debt (both centre and states) by 2022-23. Within this overall limit, a ceiling of 40 per cent was adopted by the centre and 20 per cent by the states. However, the prolonged COVID-19 crisis has worsened the fiscal positions of central and state governments, as indicated by increasing debt levels. The outstanding public debt of Kerala stood at Rs. 3,35,641 crore at the end of March 2022 against Rs. 41,792 crore in 2005. The debt to GSDP ratio steadily increased during 2011 to 2022 and stood at 37.0 per cent at the end of March 2022 against 24.2 per cent at the end of March 2011 (Figure-2). With the growing fiscal obligations of Kerala being increasingly met by debt instruments, the share of market loans in outstanding public debt consistently increased over the years from 23.0 per cent at the end of March 2005 to 54.7 per cent at the end of March 2022.

Figure-2: Trend in Public Debt of Kerala



The state has witnessed structural transformation in the composition of debt liabilities (Table-3). Market loans accounted for nearly 20 per cent of total public debt in 2000; this proportion steadily increased to 54.7 per cent by the end of March 2022. On average, the share of special securities issued to NSSF increased from 0.6 per cent during 1990-91 to 1999-2000

to nearly 14.6 per cent in 2000-01 to 2009-10; then, it started to decline and reached 6.7 per cent at the end of 2021-22. The share of loans from banks and financial institutions in outstanding debt stood at 1.5 per cent at the end of March 2022.

Table-3: Composition of Kerala State Debt (as percent of o/s debt)

Components	Market Loans	NSSF	WMA from RBI	Loans from Banks and Financial Institutions	Loans and Advances from Centre	Provident Funds, etc.	Out-standing debt
1990-91 to 1999-2000	20.4	0.6	1.0	4.1	39.6	34.3	100.0
2000-01 to 2009-10	26.8	14.6	0.8	7.8	15.4	34.6	100.0
2010-11 to 2014-15	46.9	11.3	0.0	5.2	6.5	30.0	100.0
2015-16	53.9	8.0	0.0	3.2	4.6	30.3	100.0
2016-17	53.4	7.2	0.0	2.8	4.1	32.5	100.0
2017-18	54.9	6.9	0.0	2.5	3.5	32.2	100.0
2018-19	55.8	6.7	0.0	2.2	3.5	31.9	100.0
2019-20	57.9	6.2	0.0	1.9	3.6	30.3	100.0
2020-21	55.7	6.7	0.0	1.7	3.1	32.8	100.0
2021-22	54.7	6.7	0.0	1.4	2.7	34.5	100.0

Source: State Finances: A Study of Budgets and Kerala State Budget Documents

The composition of loans and advances received from the central government exhibits structural changes (Table-3). The crucial components of this source are nonplan loans, loans for state plan schemes, loans for central plan schemes, and loans for centrally sponsored schemes. The share of provident funds in the outstanding public debt of Kerala is almost stable at approximately 32 per cent throughout the study period.

Cost of Outstanding Public Debt

The public debt management strategy is based on two broad pillars: low cost and risk mitigation. Table-4 lists the weighted average cost of public debt across the various categories of outstanding debt of Kerala. Market borrowings form the most crucial component of the public debt of state governments. Because the cost of market borrowings is driven by the market, the weighted average cost is mainly a function of the interest rate environment. The weighted average cost for issuances made in 2021-22 stood at 7.11 per cent, which was higher than that in 2020-21. The cost of market borrowings in outstanding public debt gradually declined from 2019-20 to 2021-22 and stood at 7.72 per cent at the end of March 2022. However, the costs of borrowings from other sources, such as NSSF, and financial institutions or banks were above the market-determined rates. NABARD lends at subsidised rates for agriculture-allied projects. Thus, the cost of borrowings from NABARD is below that of market loans.

Table-4: Weighted Average Cost of Public Debt (in per cent)

Category	Raised during the fiscal year			Outstanding Stock (end March)		
	2019-20	2020-21	2021-22	2020	2021	2022
Market Borrowings	7.43	6.41	7.11	8.20	7.84	7.72
Special Securities issued to the NSSF	8.20	7.40	7.30	8.38	7.97	7.60
Borrowings from Financial Institutions/Banks	13.87	9.25	11.61	10.01	10.70	11.53
Borrowings from NABARD	3.76	2.84	2.75	6.18	6.08	4.23
WMA/OD from RBI	6.68	4.60	3.40	4.40	-	-
Small Savings	5.42	5.42	4.00	5.42	5.42	5.46
Provident Funds	7.80	7.10	7.10	7.80	7.10	7.10

Source: Kerala State Budget Documents

During the course of year, if temporary mismatches occur between the receipts and expenditure of a state, the RBI offers a ways and means advance (WMA) that is capped. If a state requires additional temporary assistance, the RBI offers an overdraft (OD) facility that is limited by the number of days. The cost of borrowings from the RBI is the repo rate for WMA and repo rate + 2 per cent for the OD facility. The costs of borrowings from small savings and state provident funds are notified on regular basis. The cost of outstanding borrowings from small savings and state provident funds stood at 5.46 per cent and 7.10 per cent, respectively, at the end of March 2022. The low cost objective is attained by adopting debt portfolio management practices and creating a prudent debt structure by containing potential risks.

Risk Metrics of Market Loans of Kerala

Risk analysis focuses on metrics such as the weighted average cost, average time to maturity, redemption profile, and duration/convexity of securities. To determine the risk dynamics of the market loans of Kerala, we calculated the risk metrics (Table-5). Despite increased borrowings over the years, the trend of the weighted average cost exhibited a downward movement after 2015. The weighted average cost stood above 8.00 per cent until 2019-20 and decreased significantly to 7.72 per cent by the end of March 2022, mainly because of the issuance of market loans with shorter tenures in 2020-21. The weighted average residual maturity of the outstanding stocks of Kerala market loans declined significantly as of end March 2021 due to the issuance of loans with short tenure in 2020-21. Thus, the weighted average maturity of outstanding Kerala market loans declined from 6.48

years at the end of March 2020 to 5.89 years at the end of March 2021, which is an alarming signal. Furthermore, at the end of March 2022, the weighted average maturity increased to 6.65 years mainly due to the issuance of securities with longer tenures in 2021-22. The elongation of portfolio maturity is the preferred strategy for limiting the refinancing risk of government debt.

Table-5: Risk Metrics of Market Loans of Kerala

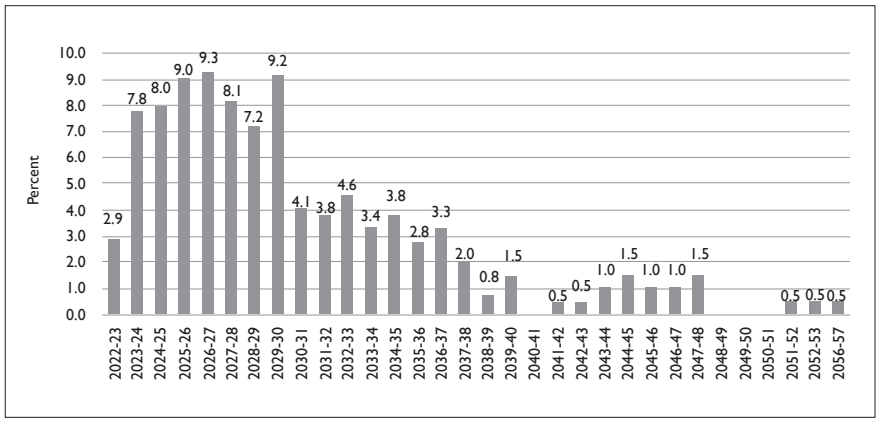
As end March	Wtd. Avg. Cost	Wtd. Avg. Maturity	Macaulay's Duration	Modified Duration	Convexity
2013	8.26	7.02	3.97	3.81	23.52
2014	8.53	8.09	4.16	3.98	25.04
2015	8.58	6.59	4.27	4.10	27.41
2016	8.56	6.43	4.45	4.29	29.55
2017	8.41	6.29	4.54	4.39	30.71
2018	8.27	6.83	4.54	4.37	30.28
2019	8.31	6.78	4.61	4.45	30.81
2020	8.20	6.48	4.61	4.46	32.30
2021	7.84	5.89	4.17	4.05	29.89
2022	7.72	6.65	4.32	4.18	34.43

Source: Database on Indian Economy and Author's calculation

The relatively stable duration and convexity of outstanding loans indicate that interest rate sensitivity has remained almost stable over the years for the market loan portfolio of Kerala. However, the magnitude of convexity is directly related to the immunisation risk inherent in the loan portfolio. The risk is proportional to portfolio convexity. Thus, portfolio convexity may be accounted for in pricing. These facts should be considered when formulating the market borrowing strategy.

The maturity profile of state borrowings is a crucial indicator of roll-over risks and debt servicing costs, which reduces the efficacy of debt management strategies. The bunching of the maturity profile of Kerala state borrowings around the 10-year bucket has aggravated redemption pressure on the state starting from 2022-23 and peaking in 2026-27 (Figure-3), warranting the development of strategies for the elongation of maturities. As of December 31, 2022, approximately 61.5 per cent of Kerala's outstanding market loans will be required to be repaid in the coming 7 years, which increases the roll-over risk of Kerala's borrowings. The state government must ensure additional revenue resources and devise a well-considered debt management strategy to meet this repayment burden.

Figure-3: Maturity profile of Kerala State Government Securities (in per cent) as on December 31, 2022



Impact of Public Debt on Economic Growth

Before performing regression analysis, we performed the unit root test to determine the order of integration of variables to prevent spurious regression. The results of the augmented Dickey-Fuller unit root test revealed that the variables were either I (0) or I (1) at level, but they were all stationary at the first difference. Thus, none of them were integrated on an order higher than one. The fact that the variables were integrated of different orders at level makes the ARDL bound testing approach appropriate for empirical estimation.

Table-6: Results of ADF Unit Root Test

Variables	Level				First difference			
	Constant		Constant & Trend		Constant		Constant & Trend	
Growth	-4.6036	(0.0007)	-4.5892	(0.0039)				
Debt	-1.6196	(0.4630)	-2.1320	(0.5121)	-4.4950	(0.0009)	-4.4313	(0.0058)

Source: Author's estimates

The null hypothesis of no cointegration is rejected at the 5 per cent significance level (Table-7) because the value of the computed *F* test from the parsimonious ARDL model, which is 5.6017, is greater than the upper bounds of critical values tabulated by both Pesaran, Shin and Smith (2001). This indicates the existence of a long-term equilibrium relationship between economic growth and public debt.

Table-7: Results for ARDL Bounds Testing for Cointegration

Calculated *F*-Test Statistic: 5.6017	
Critical values at 5% significance level	
Lower bound value I(0)	Upper bound value I(1)
2.72	3.83

Source: Author's estimates

The normalised long-term coefficients derived from the parsimonious ARDL model are listed in Table-8. With regard to the public debt variable inputted in the model, empirical analysis focuses on the nonlinearity of the relationship between this variable and economic growth. As explained in methodology, the nature of nonlinearity depends on the significance and the signs of the debt and debt squared terms in the model. The debt term, debt, and the squared debt term, $debt^2$, are statistically significant (Table-8). The debt term is positive, whereas the squared debt term is negative. These results indicate the nonlinear relationship between public debt and economic growth can be described by an inverted U-shaped curve. The peak of the quadratic function identifies the turning point or threshold above which the impact of additional public debt on economic growth shifts from positive to negative.

Table-8: Long-run and Short-run Coefficients from ARDL and ARDL-ECM Models

Long-run coefficients				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Debt	0.5923	0.1791	6.7297	0.0000
$Debt^2$	-0.9403	0.0059	-4.0637	0.0003
Short-run coefficients				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(GROWTH(-1))	0.1127	0.1273	0.8854	0.3832
D(DEBT)	0.6227	0.4032	-2.7775	0.0094
D(DEBT(-1))	0.5886	0.5119	1.9314	0.0629
$D(DEBT^2)$	-0.8090	0.4921	-1.6827	0.0328
$D(DEBT^2(-1))$	0.0060	0.0326	0.1851	0.8544
ECM(-1)*	-0.9038	0.2132	-4.2384	0.0002

Source: Author's estimates

The final step of the ARDL model is error correction for estimating the short-term parameter with speed of adjustment. Table-8 presents the results of the error correction model. The short run results present the nonlinear relationship between public debt and economic growth, as described by long run coefficients. In the final stage, to examine the validity of the short and long run ARDL models, we evaluated the stability of regression coefficients by using the cumulative sum (CUSUM) test. Figure-4 and 5 clearly show that the critical values do not exceed the 5 per cent level of significance. This finding indicates the absence of instability in regression coefficients and provides additional support for the robustness of the long and short run models.

Figure-4: CUSUM Stability Test

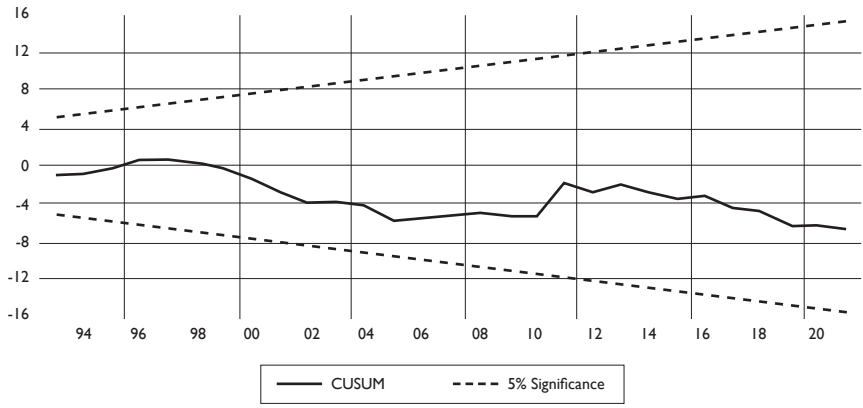
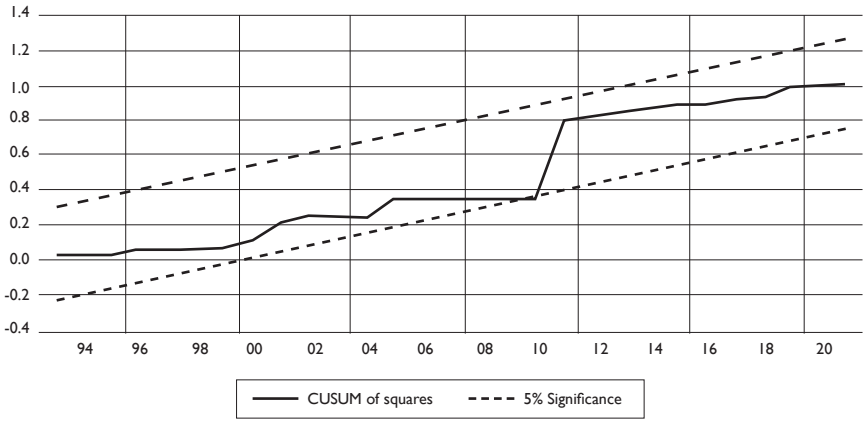


Figure-5: CUSUMSQ Stability Test



Concluding Remarks

Maintenance of fiscal discipline by state governments is vital not only from the perspective of macroeconomic stability but also to ensure adequate funding for essential social and economic services as well as building the foundation for long-term economic growth. However, the fiscal anatomy of Indian states is plagued by numerous structural deficiencies, such as high budget deficits and debt, unhealthy expenditure patterns, limited resources, and adoption of populist fiscal measures. Over the years, the fiscal deficit and share of market borrowings in financing fiscal deficits have been increasing across Indian state governments. Moreover, the rising public debt level has limited the ability of state governments to mobilise resources to achieve sustainable development goals. Kerala is no exception to this general trend. In this context, we perform this empirical study to assess the efficiency of public debt management in Kerala.

The growing fiscal obligations of Kerala are increasingly met from debt liabilities. This has led to a significant increase in the market borrowings of the state during the last decade. The increased reliance on market borrowing has resulted in public debt accumulation and high debt servicing costs. To secure the government's low-cost funding for medium and long terms while avoiding excessive risk, an assessment of public debt is important. This study empirically analysed the present debt profile of Kerala in terms of costs, maturity, and potential risk factors. In addition, we determined the dynamic relationship between public debt and economic growth by using ARDL models. The findings of this study reveal that public debt exerts a nonlinear effect on economic growth in both the long and short term, and this effect may be described by an inverted U-shaped relationship.

According to the recommendations of the 14th Finance Commission, the state government amended the Kerala Fiscal Responsibility Act by enacting the Kerala Fiscal Responsibility (Amendment) Act 2018, with the fiscal target of maintaining zero revenue deficit and fiscal deficit to 3 per cent of the GSDP. This study emphasised that the state government should control revenue and fiscal deficits to achieve the targets set in the Kerala Fiscal Responsibility Act. Market borrowings are the only source of financing where the quantum of inflows can be controlled. Small savings inflows depend on rates set by the central government, whereas other sources are primarily associated with projects. This leaves very little space for manoeuvring these states. In the case of Kerala, over the years, dependency on market borrowings and provident funds has increased for financing the fiscal deficit. During the study period, the proportion of market borrowings for financing the state's fiscal deficit reached a peak level of 65.5 per cent in 2020-21 and 48.6 per cent in 2021-22 from approximately 30 per cent in 2004-05. Moreover, the share of market loans and provident funds in outstanding public debt stood at 54.7 per cent and 34.5 per cent, respectively, at the end of March 2022. The increased reliance on market borrowing leads to debt accumulation and high interest payments. These interest payments contribute to debt. Kerala's ratio of interest payments to revenue receipts stood at 21.5 per cent and 20.0 per cent in 2020-21 and 2021-22, respectively. Such high outflows for interest payments would squeeze out space for productive government spending and reduce capital formation and growth.

The redemption profile of the Kerala state market debt reveals that redemptions would be at an elevated level in the coming 7 years. As of December 31, 2022, approximately 61.5 per cent of Kerala's outstanding market loans need to be repaid before the end of March 2030, which increases the roll-over risk of market borrowings. Moreover, the state government has to ensure additional revenue resources in coming years

to repay this debt. The analysis of the trade-off between costs and risks indicates that the state government should adopt a strategy for elongating maturity to reduce redemption pressure in the near term. To reduce the borrowing cost, borrowing requirements should be estimated, and the said amounts should be borrowed through the issuance of the borrowing calendar; this can reduce the opportunity cost.

This study investigated the impact of Kerala's public debt on its economic growth. Empirical analysis was performed using a novel methodology combining a quadratic polynomial function and the ARDL bounds approach to cointegration by using time series data spanning the period from 1981-82 to 2021-22. The results indicate that public debt exerts a nonlinear impact on economic growth in both the long and short run in Kerala. This impact may be described by an inverted U-shaped relationship. This finding is expected, particularly in the context of Kerala where most of the government borrowings are utilised to meet revenue expenditure and a small portion of it is used for forming productive capital. Moreover, the results indicate the presence of a turning point or threshold above which the effect of public debt on economic growth shifts from positive to negative. The estimated turning point of the ratio of debt to GDP equals to 31.5 per cent. This implies that below the threshold, public debt is growth enhancing in Kerala. However, beyond this turning point, additional public indebtedness would negatively affect long-term growth.

Considering the fiscal position of Kerala state, we suggest the following corrective measures. (1) In the medium term, the state government should make efforts to control fiscal deficits and stabilise debt levels to achieve the targets set in the Kerala Fiscal Responsibility Act. (2) To finance meaningful programmes that contribute to capital formation, the government should create a fiscal space by cutting revenue expenditure on nonmerit goods and increasing revenue. (3) Kerala state should strengthen its own tax revenue mobilisation. The decline in the growth of major own tax revenues must be examined thoroughly, and corrective actions must be implemented accordingly. Finally, although this study uses the widely accepted econometric methodology, the obtained results remain open to questions and debate as it did not include control variables in the ARDL framework due to the limited availability of adequate state-level data.

Disclaimer: The views expressed in this paper are those of the authors. They do not purport to reflect the views or opinions of the institution to which the authors belong.

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A Study of Interlinkages Between Indian Rupee Exchange Rate and Macroeconomic Factors

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Abstract

The present study focuses on exploring the interlinkages between Indian rupee exchange rate and macroeconomic variables using monthly data spanning January 2001 to December 2020. The ARDL bound testing technique of cointegration has been applied to analyse the relationship between real effective exchange rate of India (LREER) and selected macroeconomic factors. The results of long-run ARDL signify that almost all the variables have significant impact on Indian Rupee real effective exchange rate. The findings reveal that increase in the Indian interest rate, foreign inflation, foreign exchange reserves and trade openness lead to appreciation of Rupee. On the contrary, domestic inflation, foreign interest rate and oil prices have depreciating impact upon the Rupee. The error correction term has expected negative and significant sign which reveals that long-run equilibrium is restored by adjustments in exogenous variables at a monthly speed of 0.18%. Moreover, foreign inflation and oil prices are two major factors for which only unidirectional causality could be observed towards LREER both in long-run as well as in short-run.

Keywords: Causality, Cointegration, Error Correction, Exchange Rate

Introduction

The exchange rate of currency has consistently been a subject of rigorous debate and concern for the authorities and policymakers. Any obstacle that prevents the economy from working efficiently, eventually appears in its

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currency's international value. A stable and constant exchange rate creates assurance among investors, speculators and other participants in the global financial market, particularly for developing market economies such as India. Hence, ensuring exchange rate stability across overseas markets has become enormously significant for an economy. There are numerous fundamentals and monetary factors that cause the behavior of the exchange rate in the global financial markets, either explicitly or implicitly as evidenced by existing literature.

Since the era of the flexible exchange rate, one of the key concerns has been whether the increased exchange rate fluctuations have had a positive or negative impact on macroeconomic stability of a country. In recent decades, researchers and policymakers have paid close attention on the complexities of the relationship between the exchange rate and macroeconomic fundamentals. Although it was suggested in the early 1970s that switching from fixed to flexible exchange rates would make exchange rates more stable in the long run, in reality, exchange rate fluctuations have been rather increasing constantly over the last 20 years.

A host of factors such as global investment portfolios, efficiency in volume of foreign trade, foreign exchange reserves, sovereign debt, inflation in home country, government savings and fiscal deficits that are associated with national currency expressed in terms of international currencies are all directly or indirectly influenced by fluctuations in exchange rate. Therefore, after recognizing that shifts or changes in exchange rates could have widespread consequences and subsequent implications on a country's overall macroeconomic performance, analysis of the behaviour of home country's exchange rate cannot be overlooked. In fact, it is fundamental to all spheres of macroeconomics. In the present study, an attempt has been made to explore the interlinkages among the exchange rate and its fundamental determinants in the context of Indian rupee. In light of this, the study seeks to examine the following hypotheses:

- H_1: No causality exists between home country's inflation (LCPI) and exchange rate of India.
- H_2: No causality exists between foreign country's inflation (LPPI) and exchange rate of India.
- H_3: No causality exists between Indian interest rate (HI) and exchange rate of India.
- H_4: No causality exists between US interest rate (FI) and exchange rate of India.
- H_5: No causality exists between foreign exchange reserves(FEX) and exchange rate of India.

- H_6: No causality exists between international oil prices (LOP) and exchange rate of India.
- H_7: No causality exists between trade openness (TO) and exchange rate of India.

Review of Literature

Numerous fundamentals of exchange rate have already been explored in literature by employing diverse methodologies. A few of these available studies that have been reviewed for analysis is discussed below in the chronological order:

Kanas (2005) examined the empirical relationship for the economies of UK and US between the real exchange rate and the real production differential and also between the real exchange rate and the real interest rate differential. The study covered the period 1921:1 to 2001:12. i.e., including both the periods of fixed and floating exchange rate. The Markov switching vector autoregression (MS-VAR) and Granger causality tests model has been used. The study concluded that lagged differences of real interest rate differentials have an impact on fluctuations in exchange rates in periods marked by high volatility. On the contrary, lagged real output differentials did not impact the changes in real exchange rates in either high or low volatility times. Further, the correlation is higher in the period of low volatility in comparison to the high volatility periods where the correlation is very low.

Candelon et al., (2007) assessed fundamental bilateral real exchange rates against the euro. A panel-cointegration method over the period 1993 to 2003 for a set of eight EU new Member States was used. Two homogeneous blocks consisting of three Baltic countries namely Latvia, Lithuania and Estonia and five Central European countries- The Czech Republic, Hungary, Poland, Slovenia and Slovakia were selected for the study. The dynamic ordinary least square method was firstly used for estimating the long-term relationship between real bilateral exchange rates, demand, productivity and openness. The result shows that real exchange rates were constantly appreciating and a significant positive correlation between productivity levels and the corresponding real exchange rates have been observed. At the same time, a stable and significant negative relationship between openness and the real exchange rate was found.

Chowdhury (2012) explored the dynamics, structural breaks and determinants derived from an inter-temporal general equilibrium model of Australia's real exchange rate (RER). Various domestic policy-related as well as non-policy RER fundamentals were examined by employing ARDLco-integration and error correction approach. The properties of time-series data were also checked in the presence of structural breaks

by applying unit root test on the data series of each variable. It has been observed that terms of trade, government expenditure and net foreign liabilities positively associated with RER whereas interest rate differential, openness in trade and technological and productivity improvements negatively affect the Australia's real exchange rate in the long run. The structural breaks endogenously determined were statistically insignificant.

Ranadive & Burange (2013) figured out the factors influencing India's real exchange rate considering quarterly time period from 1993 Q1 - 2011 Q4. The determinants taken into account are government expenditure, FIIs, trade openness, terms of trade, forex reserves, net foreign assets, interest rate and inflation differentials. The long-run relationship among these variables has been confirmed by the ARDL bounds testing method. Also, 76 percent convergence towards the long run equilibrium level was predicted by the error correction term for the upcoming quarter.

Abudalu & Ahmed (2014) observed the impact of the long-run and short-run variables namely domestic interest rate, foreign interest rate, net foreign assets, inflation rate, domestic money supply, terms of trade and real gross domestic product against the UK pound on REER in ASEAN-5 countries namely Malaysia, Indonesia, Thailand, Philippines and Singapore. The quarterly data from 1991:Q1 - 2006:Q2 was collected for each sample country. For the estimation of long run ARDL approach to co-integration was applied. For Malaysia foreign interest rate; for Indonesia, domestic money supply, the foreign interest rate and real gross domestic product; for Philippines, the domestic money supply and terms of trade (TOT); for Thailand, the domestic interest rate and foreign interest rate; for Singapore, foreign interest rate, domestic money supply and real gross domestic product were the long run driving variables respectively.

Chaudhary et al., (2016) made an attempt to test the behavioural trends of Asian economies considering Pakistan, India, Bangladesh and Sri Lanka from the South Asian zone, while Malaysia, Singapore, Indonesia and Thailand for Southeast Asian zone. The ARDL co-integration approach and error correction model has been applied to explore the long-term and short-term causality between exports and exchange rate on the one hand and imports and exchange rate on the other covering a period of 1979-2010. The study concluded that for Pakistan, India, Sri Lanka, Bangladesh and Indonesia, a significant long-term relationship between the exchange rate and exports exists. Conversely, long run relation between exchange rate and imports has been observed in case of Sri Lanka only.

Venkatesan & Ponnamma (2017) employed ARDL model over a period from 2000-2015 i.e., for 15 years to analyse the influence of macroeconomic variables in relation to the exchange rate. The ADF unit root test, Vector auto-regression (VAR), ARDL, VAR Granger Causality and other residual diagnostics were applied for analysis purpose. Based on the findings of the

study, foreign direct investment has a long-term impact on the Indian rupee fluctuations. Likewise, inflation has negative impact on the rupee exchange rate. Overall, it is evident that several macroeconomic factors proved to have a significant impact on volatility of the exchange rate.

The study by Alam et al., (2020) focus to explore the influence of crude oil prices on the rupee-dollar exchange rate by applying monthly data from January 2001 to May 2020. Along with price of crude oil per barrel, the study considered the money supply, real GDP, differential in short-term interest and inflation rates between two countries as the determinants that contribute in defining the exchange rate. The analysis has been carried out using VECM, the Wald test and Johansen's cointegration method. The exchange rate and oil prices have been found to have a negative relationship in the long-run but a positive relationship in the short-run. Wald statistics reveal the short-run causation among the exchange rate,the interest rate differential and the oil prices.

Asadullah et al., (2021) forecasted the Pakistani Rupee vis-à-vis US dollar considering the monthly data from Jan. 2011 to Dec. 2020 by employing a range of forecasting methods. They incorporate one multivariate model NARDL, along with three univariate time series forecasting model, namely, Naive, ARIMA and Exponential smoothing. The results highlighted that having the lowest MAPE value, the NARDL and Naive model combo surpass all other single and combined models. It concluded that Pakistan rupee vis-à-vis the US dollar depends on latest time series observations and also on other macroeconomic factors discussed in the study.

The above listed review of studies on Indian rupee exchange rate and its determinants does not provide any clue about causal relationship among rupee exchange rate and macroeconomic determinants. The present study is an attempt in this direction and brings out the interlinkages among Indian rupee exchange rate and selected macroeconomic determinants.

Objectives of the Study

The study will focus on attaining the following objectives:

- To explore the interlinkages among REER of Indian Rupee and macroeconomic variables.
- To determine the long-run and short-run causal relationship among selected macroeconomic factors and REER of Indian Rupee.

Data Description

To perform the analysis for the objectives mentioned, monthly data for the period spanning over January 2001 to December 2020 has been taken into consideration. The data has been retrieved from the Handbook of Statistics on Indian Economy (RBI) and the data for United States producer price

index (PPI) and US interest rate (FI) have been taken from the official website of Federal Reserve Bank of St. Louis (FRED). The oil prices are as per the Energy Information Administration's West Texas Intermediate (WTI) crude oil spot prices. The variables considered are real effective exchange rate (LREER), consumer price index of India (LCPI), producer price index of US (LPPI), Indian interest rate (HI), interest rate of US (FI), foreign exchange reserves (FEX), crude oil prices (LOP)and trade openness (TO) which has been computed as a ratio of country's total export and import to GDP. Here, interest rate is yields on 91-days treasury bill in case of both the countries. Also, LREER, LCPI, LPPI and LOP have been converted into natural logarithm form. In case of foreign exchange reserves, it has been taken as a ratio of total import of the country for normalisation purpose.

Research Methodology

Unit Root Test

Examining the variables for stationarity is preliminary for the analysis of time series data. It should be verified that whether variables are stationary or not stationary. Thus, for this purpose, conventional stationarity tests, such as the Augmented Dickey Fuller (ADF) by Dickey & Fuller (1979) and Phillips & Perron (PP) test (1988), have been applied. The ADF regression equations is as follow:

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{m=1}^{n} \beta_m \Delta Y_{t-m} + \mu_t \quad \ldots(1)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{m=1}^{n} \beta_m \Delta Y_{t-m} + \mu_t \quad \ldots(2)$$

where, Δ is the first difference operator, α_0 is intercept or constant term, Y_t is a time series, k and μ_t is residual or error term. Based on these equations, the following hypotheses have been tested to assess the stationarity among the variables considered:

H0: The series have a unit root [I(0)]

H1: The series do not have a unit root [I(1)].

Autoregressive Distributed Lag (ARDL) Cointegration Approach

First step in the Autoregressive distributed lag (ARDL) method of co-integration approach is to conduct a bounds test where the F-statistics value indicates whether cointegration exists or not. Thereafter, a comparison is made between the calculated F-statistic and the critical values provided by Pesaran & Pesaran (1997) or Pesaran et al.,(2001). The null hypothesis of no cointegration can be rejected if the F-test statistic exceeds the upper

critical value. On the contrary, the null hypothesis is not rejected if the F-test statistic is lower than the lower critical bound range. The outcome is considered as inconclusive if the sample F-test statistic is in between the band of these two critical bounds. Bounds test normalizing on real effective exchange rate is expressed as below:

Fy (LREER/ LCPI, LPPI, HI, FI, FEX, LOP, TO)

The lag length of the constructed model has been selected by using Akaike information criteria (AIC). ARDL equation which will be estimated by using the ordinary least squares (OLS) is specified as below:

$$LREER_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta LREER_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta LCPI_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta LPPI_{t-1} + \sum_{i=1}^{p} \beta_4 \Delta HI_{t-1} + \sum_{i=1}^{p} \beta_5 \Delta FI_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta FEX_{t-1} + \sum_{i=1}^{p} \beta_7 \Delta LOP_{t-1} + \sum_{i=1}^{p} \beta_8 \Delta TO_{t-1} + \gamma_1 LREER_{t-1} + \gamma_2 LCPI_{t-1} + \gamma_3 LPPI_{t-1} + \gamma_4 HI_{t-1} + \gamma_5 FI_{t-1} + \gamma_6 FEX_{t-1} + \gamma_7 LOP_{t-1} + \gamma_8 TO_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where Δ is the first difference operator, where β_0 represent the intercept and μ_t is the white noise error term. The Δ terms indicate the dynamics for error correction in the short run while the long-run relation is presented in the subsequent half of the equation that is symbolised using γ coefficients. Having confirmed the long-term relationship by F-statistic and model estimation, the error correction model (ECM) is expressed as follows:

$$\Delta LREER_t = \lambda_0 + \sum_{i=1}^{p} \lambda_1 \Delta LREER_{t-1} + \sum_{i=1}^{p} \lambda_2 \Delta LCPI_{t-1} + \sum_{i=1}^{p} \lambda_3 \Delta LPPI_{t-1} + \sum_{i=1}^{p} \lambda_4 \Delta HI_{t-1} + \sum_{i=1}^{p} \lambda_5 \Delta FI_{t-1} + \sum_{i=1}^{p} \lambda_6 \Delta FEX_{t-1} + \sum_{i=1}^{p} \lambda_7 \Delta LOP_{t-1} + \sum_{i=1}^{p} \lambda_8 \Delta TO_{t-1} + \psi ECM_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots (4)$$

In the above equation, λ_0 is constant term, $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6, \lambda_7$ and λ_8 are the short-run dynamic coefficients and ψ is the coefficient of error correction term (ECT_{t-1}) which depicts the long-run equilibrium speed of adjustment following a shock or disturbance in short-run. To verify the goodness of fit for the model, various diagnostic tests such serial correlation, heteroscedasticity test and functional form have been conducted. Additionally, to assess the stability of model, the study employed the cumulative sum of recursive residual(CUSUM) stability test proposed by Brown et al., (1975) which suggests that we cannot reject the null hypothesis if the CUSUM statistics stay within the critical bound of the 5% level of significance and it will confirm that the model is consistent and stable.

Results and Discussion

To determine which cointegration test should be applied, empirical data analysis necessitates the time series data to be stationary. In order to ascertain the order of integration of the variables considered, the study primarily used two unit root tests, the ADF test and the PP tests.

The findings of both the ADF and PP unit root tests with intercept as well as with intercept and trend are shown in Table-1. Before examining the stationarity at first differenced series, it has been firstly examined at the level. The findings reveal that most of the variables are non-stationary at level I(0) and stationary at first difference I(1) except REER, Indian interest rate, foreign exchange reserves and oil prices as these variables are stationary at level I(0). Both the unit root tests exhibit almost similar results and hence, when variable series are a mixture of I(0) and I(1) and no variables are integrated of order two, i.e., I(2) or higher, the ARDL bounds testing approach can be applied in such a situation.

Table-1: Result of ADF and PPunit root test for REER and macroeconomic variables:

	Augmented Dickey Fuller Test (ADF)				Phillips-Perron test (PP)			
	Level		First Diff.		Level		FirstDiff.	
Variables	With Intercept	With Trend and Intercept	With Intercept	With Trend and Intercept	With Intercept	With Trend and Intercept	With Intercept	With Trend and Intercept
LREER	0.425	0.015**	0.000*	0.000*	0.408	0.037**	0.000*	0.000*
LCPI	0.909	0.873	0.000*	0.000*	0.951	0.866	0.000*	0.000*
LPPI	0.651	0.553	0.000*	0.000*	0.594	0.600	0.000*	0.000*
HI	0.094***	0.284	0.000*	0.000*	0.140	0.378	0.000*	0.000*
FI	0.192	0.547	0.000*	0.000*	0.105	0.366	0.000*	0.000*
FEX	0.040**	0.156	0.000*	0.000*	0.002*	0.011**	0.000*	0.000*
LOP	0.070***	0.253	0.000*	0.000*	0.186	0.566	0.000*	0.000*
TO	0.753	0.217	0.000*	0.000*	0.814	0.278	0.000*	0.000*

*, ** and *** shows 1%, 5% and 10% level of significance respectively.

The existence of a long-run association among variables is revealed by a significant F-statistics through ARDL bounds test as shown in Table-2. Here, in order to analyse the cointegration among the variables, each variable is made dependent one by one to obtain F-statistic in each case.

Table-2: Results of Bounds Test of Cointegration for Normalizing LREER and All Variables One by One

Dependent Variables	F- Statistics	Results
F_{LREER} (LREER/LCPI, LPPI, HI, FI, FEX, LOP, TO)	5.148	Cointegration
F_{LCPI} (LCPI/LREER, LPPI, HI, FI, FEX, LOP, TO)	4.071	Cointegration
F_{LPPI} (LPPI /LREER, LCPI, HI, FI, FEX, LOP, TO)	0.839	No Cointegration
F_{HI} (HI /LREER, LCPI, LPPI, FI, FEX, LOP, TO)	5.331	Cointegration
F_{FI} (FI/ LREER, LCPI, LPPI, HI, FEX, LOP, TO)	1.096	No Cointegration
F_{FEX} (FEX/LREER, LCPI, LPPI, HI, FI, LOP, TO)	2.715	Inconclusive

Dependent Variables	F- Statistics	Results
F_{LOP} (LOP/LREER, LCPI, LPPI, HI, FI, FEX,TO)	2.632	Inconclusive
F_{TO} (TO/LREER, LCPI, LPPI, HI, FI, FEX, LOP)	2.594	Inconclusive
Critical Bounds at 5%: Lower bound = 2.32 and Upper bound = 3.50		

The overall results of bounds test indicate that cointegration exists among all the variables considered except F_{LPPI} and F_{FI}. In case of F_{LREER},the main variable of interest, the calculated F-statistic value is 5.148 which is clearly higher than the upper bound value of 3.50. This signifies that there is a cointegrating relationship between F_{LREER} and other macroeconomic factors and the hypothesis that there is no cointegration is clearly rejected at 5% level of significance. Having determined the existence of cointegration, the ARDL (2, 3, 0, 0, 2, 1, 0, 0) model specification based on equation (3) has been estimated to determine the long and short-run coefficients. The result of the long run ARDL approach with intercept and no trend are presented below in Table-3:

Table-3: Estimated ARDL long-run coefficients for LREER and Macroeconomic Factors

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.951*	1.234	4.822	0.000
LCPI	0.712*	0.146	4.848	0.000
LPPI	-1.280*	0.486	-2.630	0.009
HI	-0.012**	0.005	-2.280	0.023
FI	0.024*	0.005	4.516	0.000
FEX	-0.004	0.003	-1.358	0.175
LOP	0.059***	0.031	1.878	0.061
TO	-0.000*	0.000	-4.613	0.000

*, ** and *** shows 1%, 5% and 10% level of significance respectively.

The equation derived from long-run ARDL model is as follows:

LREER = 5.951* + 0.712*(LCPI) - 1.280*(LPPI) -0.012**(HI) + 0.024*(FI) -0.004(FEX)
+ 0.059***(LOP)- 0.000*(TO) ...*(5)*

The results signify that almost all the variables taken into account have a statistically significant impact on Indian real effective exchange rate. Home country's inflation(LCPI) has positive and significant sign which implies that increase in home country's inflation increases the exchange rate of rupee vis-à-vis US dollar and thus causes the depreciation of Indian Rupee and vice-a-versa. Thus, higher domestic inflation relative to that of other nations results into depreciation of domestic currency. On the contrary, Indian currency appreciates as a result of higher inflation in foreign country as represented by LPPI. Likewise, the Indian interest rate (HI) has negative and significant impact on LREER which signifies that an

increase in the domestic interest rate would enhance capital inflows and this in turn causes the domestic currency to appreciate relative to other currencies. Further, foreign interest (FI) has significant and positive impact on LREER which signals that an increase in the foreign country's interest rate would results in capital outflows from India leading to depreciation of Indian rupee. Similarly, an increase in the foreign exchange reserve (FEX) leads to an increase in the availability and supply of foreign currency, as a consequence of which domestic currency tends to appreciate but this relationship between foreign exchange reserves and Indian rupee exchange is slightly insignificant. This might be due to the fact that recently the foreign exchange reserves have fallen. Thus, this relationship may be firmly established if foreign exchange reserves rise commensurate to the import demand.

Oil prices (LOP) have positive impact on LREER which clearly brings out that an increase in oil prices would depreciate the value of Indian Rupee. This is because an increase in the prices of oil increases the demand for foreign currency to make the payment for the oil import bills. Trade openness (TO) has negative and significant impact on LREER which implies that more openness by the economy and increase in the export will provide stability to the Indian rupee and will prevent from further fall in the exchange rate of domestic currency.

Table-4: Error-Correction model representation on the basis of ARDL model (2, 3, 0, 0, 2, 1, 0, 0):

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LREER(-1))	0.140**	0.062	2.239	0.026
D(LCPI)	0.725*	0.174	4.150	0.000
D(LCPI(-1))	-0.039	0.332	-0.118	0.906
D(LCPI(-2))	-0.310***	0.173	-1.788	0.075
D(LPPI)	-0.235*	0.082	-2.858	0.004
D(HI)	-0.002**	0.000	-2.502	0.013
D(FI)	0.012**	0.005	2.329	0.020
D(FI(-1))	-0.016*	0.005	-2.973	0.003
D(FEX)	-0.001*	0.000	-2.890	0.004
D(LOP)	0.010***	0.005	1.957	0.051
D(TO)	-0.000*	0.000	-3.829	0.000
ECT (-1)	-0.184*	0.031	-5.825	0.000

*, ** and *** shows 1%, 5% and 10% level of significance respectively.

Table-4 depicts the results of short-run dynamics associated with the long-run equilibrium based on equation (4) following ARDL specification of(2, 3, 0, 0, 2, 1, 0, 0).The short-run results exhibit similar results as given by long-run ARDL model. The US interest rate, oil prices and inflation of India have positive and significant influence on LREER while US inflation,

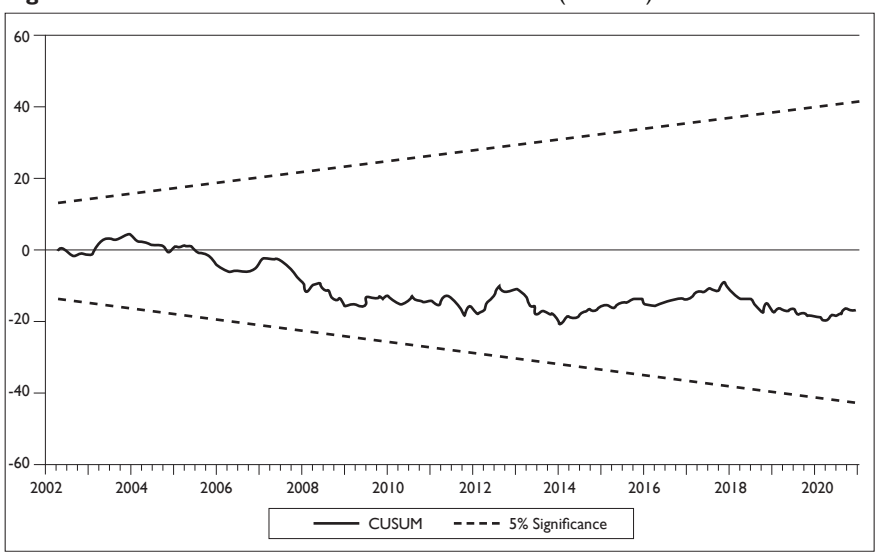
home country's interest rate, foreign exchange reserves and trade openness all have negative and significant impact. The value of the error correction term (ECT_{t-1}) has expected negative and significant sign which reveals that long-run equilibrium is restored by adjustments in short-run drivers i.e., exogenous variables at a monthly speed of 0.18% which is quite low.

Table-5: Diagnostic Tests Results

Diagnostic Test	F-statistics	Prob. value
Breusch-Godfrey Serial Correlation LM Test	0.115	0.890
ARCH Heteroskedasticity Test	1.035	0.309
Ramsey RESET Test	0.135	0.713

The model passes the residual diagnostic tests for serial correlation (Breusch-Godfrey Serial Correlation LM tests), heteroscedasticity (ARCH test) and functional form (Ramsey RESET Test) as presented in the Table-5. It is clearly evident that the model does not suffer from autocorrelation, residual heteroscedasticity and instability.

Figure-1: Plot of Cumulative Sum of Recursive Residual (CUSUM) Test



Cumulative sum of recursive residuals (CUSUM) structural stability test has been employed to further verify the robustness of our results. All these tests signify that the selected ARDL model is stable since the line lies within the range of 5% critical bands.

Granger Causality Results

The existence of cointegration among the variables indicates that there must be a causal relationship which is not demonstrated since the cointegration

test does not explain the interlinkages among the variables. Table-6 and 7 depicts the result of the analysis, which will investigate both short-run and long-run causality through Wald F- statistics and T- statistics and ECMs.

The short-run causality results as presented in Table-6 depict that a bidirectional causality has been observed between LREER and home country's inflation, LREER and home country's interest rate, LREER and US interest rate, LREER and foreign exchange reserves and LREER and trade openness at specified level of significance.

Table-6: Short-run Granger Causality Results (Wald F-Statistics and T-statistics)

Null Hypothesis	Tests	Statistics	Prob. value	Remarks
LCPI does not Granger Cause LREER	T- Statistic	4.150*	0.000	Bidirectional
	F-Statistic	9.360*	0.000	LCPI ↔ LREER
LREER does not Granger Cause LCPI	T-Statistic	4.347*	0.000	
	F-Statistic	10.57*	0.000	
LPPI does not Granger Cause LREER	T- Statistic	-2.858*	0.004	Unidirectional
	F-Statistic	8.168*	0.004	LPPI→LREER
LREER does not Granger Cause LPPI	T-Statistic	-0.296	0.767	
	F-Statistic	0.087	0.767	
HI does not Granger Cause LREER	T- Statistic	-2.502**	0.013	Bidirectional
	F-Statistic	6.264**	0.013	HI ↔ LREER
LREER does not Granger Cause HI	T-Statistic	2.031**	0.043	
	F-Statistic	3.489*	0.008	
FI does not Granger Cause LREER	T- Statistic	2.329**	0.020	Bidirectional
	F-Statistic	8.988*	0.000	FI ↔ LREER
LREER does not Granger Cause FI	T-Statistic	2.431**	0.015	
	F-Statistic	3.036**	0.049	
FEX does not Granger Cause LREER	T- Statistic	-2.890*	0.004	Bidirectional
	F-Statistic	4.178**	0.016	FEX↔ LREER
LREER does not Granger Cause FEX	T-Statistic	-3.428*	0.000	
	F-Statistic	6.577*	0.001	
LOP does not Granger Cause LREER	T- Statistic	1.957***	0.051	Unidirectional
	F-Statistic	3.831***	0.051	LOP→LREER
LREER does not Granger Cause LOP	T-Statistic	-0.858	0.391	
	F-Statistic	1.642	0.164	

Null Hypothesis	Tests	Statistics	Prob. value	Remarks
TO does not Granger Cause LREER	T- Statistic	-3.829*	0.000	Bidirectional
	F-Statistic	14.66*	0.000	TO ↔ LREER
LREER does not Granger Cause TO	T-Statistic	-2.235**	0.026	
	F-Statistic	4.862*	0.002	

*, ** and *** shows 1%, 5% and 10% level of significance respectively.

The results also expose a short-run unidirectional causality from US inflation and international crude oil prices towards real effective exchange rate of India. Both Wald F- statistics and t- statistics reveal consistent results and hence provide robustness to each other. Thus, in short-run LREER is driven by oil prices and US inflation which signifies that oil prices and foreign inflation have significant and dominating role in shaping REER of Indian currency because only one way causality means Indian currency fluctuation do not push the oil prices and foreign inflation.

Table-7: Long-run Granger Causality Results (T-statistics)

Null Hypothesis	T-Statistic	Prob.Value	Remarks
LCPI does not Granger Cause LREER	4.848*	0.000	Unidirectional
LREER does not Granger Cause LCPI	-0.021	0.982	LCPI→LREER
LPPI does not Granger Cause LREER	-2.630*	0.009	Unidirectional
LREER does not Granger Cause LPPI	-0.302	0.762	LPPI→LREER
HI does not Granger Cause LREER	-2.228*	0.002	Bidirectional
LREER does not Granger Cause HI	1.653***	0.099	HI ↔ LREER
FI does not Granger Cause LREER	4.516*	0.000	Unidirectional
LREER does not Granger Cause FI	1.354	0.177	FI→LREER
FEX does not Granger Cause LREER	-1.358	0.175	No Causality
LREER does not Granger Cause FEX	-0.005	0.995	--
LOP does not Granger Cause LREER	1.878***	0.061	Unidirectional
LREER does not Granger Cause LOP	1.429	0.154	LOP→LREER
TO does not Granger Cause LREER	-4.613*	0.000	Bidirectional
LREER does not Granger Cause TO	-3.224*	0.001	TO ↔ LREER

*, ** and *** shows 1%, 5% and 10% level of significance respectively.

Table-7 summarises the results of the long-run granger causality based on t-statistics value provided by long-run ARDL model after considering each variable as dependent one after another. The results reveal a long-run unidirectional causality from LCPI, LPPI, FI and LOP towards LREER. This implies that all these macroeconomic variables have a considerable impact in causing LREER in India. The results also observed a bidirectional causality running between LREER and home country's interest rate, LREER and trade openness during the study period. Also, in case of FEX and LREER, the insignificant the t-statistic value indicates that there is no

long-run causality exists between both these variables. Foreign inflation and oil prices are two major foreign variables for which unidirectional causality has been observed towards LREER. This situation of unidirectional causal impact from LPPI and LOP towards LREER holds both in short-run as well as in long-run. It clearly brings out the vulnerability of Indian rupee exchange rate since it is being pushed by foreign inflation and oil prices but itself does not cause these variables. Thus, these two variables of foreign inflation and oil prices are two major drivers of Indian rupee exchange rate.

Table-8: Long-run causality results (Based on ECT_{t-1})

Variables	ECT_{t-1}	Prob. Value
ΔLREER/ΔLCPI, ΔLPPI, ΔHI, ΔFI, ΔFEX, ΔLOP, ΔTO	-0.18*	0.000
ΔLCPI/ΔLREER, ΔLPPI, ΔHI, ΔFI, ΔFEX, ΔLOP, ΔTO	-0.04*	0.000
ΔLPPI /ΔLREER, ΔLCPI, ΔHI, ΔFI, ΔFEX, ΔLOP, ΔTO	-0.02	0.162
ΔHI /ΔLREER, ΔLCPI, ΔLPPI, ΔFI, ΔFEX, ΔLOP, ΔTO	-0.18*	0.000
ΔFI/ΔLREER, ΔLCPI, ΔLPPI, ΔHI, ΔFEX, ΔLOP, ΔTO	-0.03**	0.010
ΔFEX/ΔLREER, ΔLCPI, ΔLPPI, ΔHI, ΔFI, ΔLOP, ΔTO	-0.24*	0.000
ΔLOP/ΔLREER, ΔLCPI, ΔLPPI, ΔHI, ΔFI, ΔFEX,ΔTO	-0.10*	0.001
ΔTO/ΔLREER, ΔLCPI, ΔLPPI, ΔHI, ΔFI, ΔFEX, ΔLOP	-0.16*	0.000

*, ** and *** shows 1%, 5% and 10% level of significance respectively.

Table-8 summarises the results of the long-run granger causality based on error correction term (ECT_{t-1}) by considering each variable as dependent one after another. In the LREER equation, the coefficient of ECT is negative and significant meaning that there is long-run causality running from LCPI, LPPI, HI, FI, FEX, LOP, TO to LREER. This implies that all these macroeconomic variables have a considerable impact on LREER. Similarly, in case of other equations of LCPI, HI, FI, FEX, LOP and TO, the statistically significant and negative value of ECT again reveals a long-run causal relationship running from considered macroeconomic variables to these dependent variables. The only exception is US inflation rate which have insignificant ECT value. These long-run results of causality based on ECT further support the short-run causality test (Wald F-statistics and T- statistics) and long-run causality test (T- statistics and ECT_{t-1}).

Conclusion and Policy Implications

The present study focuses on exploring the interlinkages between Indian rupee exchange Rate and macroeconomic stability of Indian economy by employing monthly data spanning over January 2001 to December 2020. The findings exhibit that in the long-run, home country's inflation has positive and significant impact which implies that increase in home country's inflation would depreciate the value of Indian Rupee and vice-

a-versa. On the contrary, Indian currency appreciates as a result of higher inflation in foreign country which is due to the fact that higher inflation in foreign country causes the capital inflows into the domestic economy from foreign countries and thus contributes to the foreign exchange reserves of the domestic economy. The Indian interest rate has negative and significant impact on LREER which highlights that an increase in the domestic interest rate would attract more capital inflows and this ultimately causes the domestic currency to rise. While an increase in the US interest rate will cause capital outflows from India and this in turn leads to depreciation of Indian rupee. Further, an increase in the foreign exchange reserve leads to an increase in the availability of foreign currency, as a consequence of which domestic currency tends to appreciate. Oil prices have positive impact on LREER signifying that as a result of increase in oil prices, domestic currency tends to depreciate. Also, trade openness has negative and significant impact on LREER which signals that more openness by the economy and increase in the export will provide stability to the Indian rupee and will prevent further fall in the exchange rate of domestic currency. Further, the value of the error correction term (ECT_{t-1}) has expected negative and significant sign which reveals that long-run equilibrium is restored by adjustments in short-run drivers i.e., exogenous variables at a monthly speed of 0.18%.

Foreign inflation and oil prices are two major foreign variables for which unidirectional causality has been observed towards LREER. This situation of unidirectional causal impact from LPPI and LOP towards LREER holds both in short-run as well as in long-run. It clearly brings out the vulnerability of Indian rupee exchange rate since it is being pushed by foreign inflation and oil prices but itself does not cause these variables. Thus, these two variables of foreign inflation and oil prices are two major drivers of Indian rupee exchange rate. It implies that the instability of Indian rupee exchange rate in the near future cannot be ruled out as our oil import demand is inelastic in case of India and foreign inflation is uncontrollable at the instance of India. It is suggested that oil imports should be reduced as far as possible by resorting to other means of energy.

It is also observed that bi-directional long-run as well as short-run causality running between LREER and Indian interest rate, LREER and trade openness. Short-run bidirectional causality is running between LREER and Indian inflation, LREER and foreign interest rate as well as between LREER and foreign exchange reserves. Additionally, long-run causal results disclose that a unidirectional causality is running from LCPI and FI towards LREER. It is also suggested that in order to provide stability to the Indian rupee exchange rate, policymakers should continuously monitor the changes in the identified factors and consider the suggested policy implications.

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Financial Literacy and Behavioural Biases of Stock Market Investors in Kerala: An Empirical Analysis

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Abstract

The relationship between financial literacy and behavioural biases has been of recent interest in behavioural or financial economics literature in India. Using primary survey of 120 stock market investors in Kerala, this study attempts to understand their level of financial literacy and behavioural biases, and how it differ across sample characteristics. The study uses statistical measures like mean, median, and non-parametric tests for the analysis. The overall financial literacy score of stock market investors is found to be high. The investors are prone to representativeness, availability, anchoring, disposition effect, and overconfidence biases. The presence of herding bias was found to be weak. Non-parametric tests indicates investors' financial literacy differs significantly across education, overconfidence bias, and disposition effect. Further, based on the financial literacy and biases scores, we classify the investors into four categories. The study attempts to add to the growing literature on financial literacy and behavioural biases in Kerala, and would help individuals as well as finance professionals make better investment decisions.

Keywords: Behavioural Biases, Financial Literacy, Household Finance, Stock Market

Introduction

An individual's investment decision is influenced by various factors, of which financial literacy and behavioural biases are the most important. The concept of financial literacy popularized by Lusardi and Mitchell through

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the Big Three and Big Five questions was later extended by Van Rooij et al. (2007) to analyze household stock market participation, which continue to puzzle researchers due to its persistent low rate. They found the decision to participate in the stock market is determined mainly by financial literacy levels, such that individuals with advanced financial literacy are more likely to invest in the stock market than those with basic financial literacy. Apart from stock market participation, financial literacy influences various aspects of investment decisions, such as portfolio diversification, investment returns, and risk tolerance (Awais et al., 2016; Chu et al., 2017; Mouna, 2015). Recent interest is the relationship between financial literacy and various behavioural biases in investment decision.

Financial literacy and behavioral economics rose to prominence around the same time i.e. post global financial crisis (Wolf, 2018). Researches in both the field remained fairly isolated from each other till the recent past. The paper by Lin (2011) examining the rational decision-making process and biases like overconfidence, herding and disposition effect among the investors in Taiwan is one of the foremost works on rationality and behavioural biases in investment decision-making. Subsequent studies examined the relationship between financial literacy and biases (Ates et al. 2016; Bellofatto etal. 2018; Baker et al, 2019; Rasool & Ullah, 2019) and their influence on investment decisions (Raut, 2020). Financial literacy is believed to improve individual investors' decisions towards making rational choices, while behavioural biases cause them to make irrational decisions and earn lower returns. Thus, these two factors influence each other, affecting the overall quality of investment decisions.

The relationship between financial literacy and behavioural biases is not straightforward in the real world. Major works on financial literacy-behavioural biases relationship in the Indian context include Adil et al. (2022); Baker et al. (2018); Goyal (2017); Raut (2020) among others. They indicate that the effect of financial literacy is not the same across behavioural biases. Financial literacy could aggravate behavioural biases, sometimes exert an insignificant impact on them, and may also reduce its adverse effect on decision-making. Also, the relationship varies across individuals and geography, further deviating from the straightforward relationship that financial literacy reduces behavioural biases. In this context of conflicting evidence, this paper attempts to examine the financial literacy and behavioural biases of stock market investors in the context of the most literate state in India, Kerala.

Literature Review

Studies on the influence of financial literacy on investor psychology has gained popularity in the recent times. Individual investors' decision-making

is rational but simultaneously subjected to various psychological biases (Lin, 2011; Kumar & Goyal 2016; Mushinada & Veluri, 2019). Anwar et al. (2017) analyzed the effect of financial literacy and behavioural biases like familiarity, availability, and overconfidence on portfolio diversification of individual investors in Pakistan. Ullah (2015) stated that financial literacy acts as a buffer to reduce the biases and lead investors towards rational decisions. He found that the financial literacy weakened the influence of illusion of control on investment decisions, but does not influence the effect of self-serving attribution on investment decision. Ates, Coskun, Sahin and Demircan (2016) found that financial literacy reduced biases like loss aversion, framing, cognitive dissonance, and overconfidence, but increased the biases like overoptimism, representativeness and confirmation. Bellofatto, Winne and D'Hondt (2018) found that investors with a high level of subjective financial literacy show 'smarter' trading behaviour and are less influenced by disposition effect. For instance, Rasool and Ulla (2019) found that financial literacy helps to reduce the psychological biases of stock market investors in Pakistan. Mental accounting increases with financial literacy (Baker et al, 2019). Basheer and Siddiqui (2020) found that investors with high financial literacy has less disposition effect but is more likely to exhibit overconfidence. Lebdaoui, Chetioui, and Ghechi (2021) examined the relationship between behavioural biases, financial literacy, and investment performance in Pakistan. They found that investment performance is positively influenced by financial literacy, and financial literacy influenced none of the biases, but overconfidence.

Financial literacy is also used as a moderating variable in investment decision-making. Hayat and Anwar (2017) examined the moderating effect of financial literacy on the relationship between overconfidence, herding, disposition effect, and investment decisions of individual investors in Pakistan. They found that financial literacy had a moderating influence between overconfidence and investment decision. Khan (2014) found that financial literacy negatively moderated the positive relationship between framing and investment performance, but did not moderate the relationship between herding and the perceived performance of investors in Pakistan. Mahmood et al. (2020) found that financial literacy moderated the relationship between heuristics, herding, prospect and market factors in investment decision-making among Pakistani investors.

Based on a nation-wide sample of individual investors, Baker et al. (2018) analyzed the relationship between financial literacy and behavioural biases in the India. They found that the relationship between financial literacy and behavioural biases showed mixed results such that it reduces biases like disposition effect and herding, while increased mental accounting, and had an insignificant effect on anchoring bias, overconfidence bias,

and emotional bias. Suresh (2021) found the influence of financial literacy and heuristics on the investment decisions of individual investors in South India. Adil et al. (2022) analyzed the moderating role of financial literacy on various behavioural biases, and how it differs across gender. Raut (2020) extended the Theory of Planned behaviour by incorporating two new variables – financial literacy and heuristics (past behaviour) - and found that both these factors influenced individuals attitude to invest.

Objectives of the Study

- To analyze the financial literacy of stock market investors in Kerala.
- To examine the presence of selected behavioural biases among stock market investors in Kerala.
- To examine whether financial literacy differs across sample characteristics and behavioural biases.

Data and Methodology

Sample

The study is based on primary data[1]. The sample consists of 120 individuals who trade or invest in the stock market obtained using snowball sampling method. Though data on the website of the Bombay Stock Exchange indicated the presence of over 28 lakhs registered investors in Kerala in December 2022, their distribution across districts or sub-districts is not available to generate a sample frame and adopt a probability method of sample selection. As a result, a non-probability sampling method has to be resorted to, and the samples were collected from Ernakulam district of Kerala during January-February 2023. In fact, the use of non-probability method for data collection can be justified further from the existing literature in the Indian context (e.g. Antony and Iype, 2017; Chandra and Kumar, 2011; Raut and Kumar, 2018; Suresh, 2021).

Measurement

A questionnaire survey was used for collecting data related to the socio-economic profile of individual investors, financial literacy, and behavioural biases. Financial literacy was measured using a performance test of 10 multiple choice questions adopted from Van Rooij et al. (2007) and Volpe et al. (2002) after minor modification. Presence of large number of biases in the behavioural economics literature makes the selection of biases complicated for any study. Our choice of six behavioural biases are based on both theory and empirical evidence. Representativeness, anchoring, and availability heuristics were chosen based on Heuristic Theory, and overconfidence bias, herding, and disposition effect were chosen based on

empirical evidence from the literature on investor behaviour. These biases are measured using constructs already used in existing studies carried out in the Indian context (Alrabadi et al., 2018; Baker et al., 2018; Prosad et al., 2015; Raut and Kumar, 2018).

Analytical Tools

The data collected was analyzed in R Studio. Shapiro-Wilk test of normality, and non-parametric tests like Mann Whitney U test and Kruskel Wallis test were used to examine the difference in financial literacy levels across different categories of behavioural biases and socio-economic characteristics. The study also uses simple mathematical tools like percentage, mean, and median wherever necessary.

Analysis and Results

Sample Characteristics

We present the analysis and findings of primary survey of 120 stock market investors in this section. Table-1 shows the socio-economic characteristics of the respondents. Among 120 respondents, 47.5 per cent belong to middle age group (36-55 years), 28.33 per cent belong to older adult group (56 years and above), and 24.17 per cent belong to young adult group (18-35) years. The presence of female investors is 18.3 per cent and that of male is 81.7 per cent. Marital status of respondents indicate 92.5 per cent as married and 7.5 per cent as single. Educational attainment of the sample is fairly high with 62.5 per cent post graduates, and 34.17 per cent graduates, followed by 3.33 per cent with a Ph.D. The sample data include individuals employed in various sectors. For example, 36.67 per cent are working in the private sector compared to 10.8 per cent in the government sector. Self-employed individuals include 33.33 per cent, 12.5 per cent are retired, and 3.33 per cent owns a business. Annual income indicates 10.83 per cent respondents with less than Rs. 5 lakh, 29.17 per cent in Rs.5-10 lakh slab, 19.17 per cent in Rs.10-15 lakh slab, 12.5 per cent in Rs.15-20 lakh slab, and nearly 28 per cent above Rs.20 lakh slab.

Table-1: Sample Characteristics

Socio-economic characteristics	Category	Number	Percentage
Age	18-35	29	24.17
	36-55	57	47.5
	56 and Above	34	28.33
Gender	Male	98	81.67
	Female	22	18.33
Marital status	Married	111	92.5
	Single	9	7.5

Socio-economic characteristics	Category	Number	Percentage
Education	Graduation	41	34.17
	Post-graduation	75	62.5
	Doctorate	4	3.33
Employment	Government sector	13	10.83
	Private sector	44	36.67
	Self-employed	40	33.33
	Business	4	3.33
	Retired	15	12.5
	Others	4	3.33
Annual income	Less than 5 lakh	13	10.83
	5-10 lakh	35	29.17
	10-15 lakh	23	19.17
	15-20 lakh	15	12.5
	20-25 lakh	10	8.33
	Above 25 lakh	24	20

Source: Primary data

Financial Literacy of Individual Investors

Existing studies shows financial literacy plays a crucial role in stock market participation. Individuals with higher or advanced financial literacy has a higher chance of participating in the stock market (Van Rooij et al., 2007). Importance of financial literacy is further documented in relation to risk tolerance, portfolio diversification, investment returns, and behavioural biases (Awais et al., 2016; Baker et al., 2019; Mouna, 2015). Being a qualitative concept, existing studies measure financial literacy in two ways: subjective and objective financial literacy. While subjective financial literacy often takes the form of a self-assessed financial literacy on a likert scale, objective financial literacy involves multiple choice test of financial products and concepts. With respect to stock market participation, a popular construct of objective financial literacy is of Van Rooij, Lusardi, and Alessie (2007) consisting of basic and advanced financial literacy questions. While several other measures of financial literacy exists such as Al-Tamimi and Kalli (2009); Volpe et al. (2002), researchers combine one or more of these to measure financial literacy (e.g. Baker et al., 2018).

In this paper, financial literacy is measured through an objective assessment of ten multiple choice questions compiled and slightly modified from the existing measures of Van Rooij et al. (2007) and Volpe et al. (2002). Overall financial literacy score for an individual investor takes the lowest value 0 and the highest value 10. To reduce guesswork, an option to state 'don't know' the answer was included in all questions following Van Rooij et al. (2007).

Table-2: Result of Objective Financial Literacy Measure

Financial Literacy	Correct (%)	Incorrect (%)	Don't know (%)	Total (%)
Shares	92.50	4.17	3.33	100.00
Asset fluctuation	97.50	1.67	0.83	100.00
Mutual fund	93.33	5.83	0.83	100.00
Bond price and interest rate	43.33	47.50	9.17	100.00
Blue chip company	91.67	2.50	5.83	100.00
Taxation	65.00	23.33	11.67	100.00
Stock split	79.17	19.17	1.67	100.00
Portfolio diversification	98.33	1.67	0.00	100.00
Beta	28.33	25.00	46.67	100.00
Valuation	80.83	13.33	5.83	100.00

Source: Primary data

Table-2 shows the result of the objective assessment of financial literacy. Stock market investors have high knowledge about financial products such as shares, asset fluctuation, mutual fund, concept of portfolio diversification, and blue chip companies as more than 90 per cent respondents answered them correctly. Comparatively fewer individuals answered the questions related to the concept of valuation (80.83 per cent), stock split (79.17 per cent), and taxation (65 per cent). Still fewer individuals could answer the questions on bond price and interest rate (43.33 per cent), and stock beta (28.33 per cent). This shows that their understanding of advanced financial concept is limited. However, overall financial literacy of stock market investors were found to be 66.8 per cent with the maximum individual score of 10 and minimum individual score of 3. Thus, we may state that stock market investors have overall high financial literacy.

Further, the respondents are classified into two groups – high and low financial literacy-based on their median financial literacy score. Following Chen and Volpe (1998), respondents whose financial literacy score is more than median score belong to high financial literacy group, whereas whose score is less than or equal to median score belong to low financial literacy group. Likewise, respondents with financial literacy score above 8 belong to high financial literacy group and those with a score less than or equal to 8 belong to the low financial literacy group. We find that 62.5 per cent of respondents have low financial literacy and 37.5 per cent have high financial literacy (Table-3).

Table-3: Financial Literacy Levels of Stock Market Investors

Financial literacy	Number	Percentage
High	45	37.5
Low	75	62.5
Total	120	100

Source: Primary data

In order to examine whether financial literacy levels differ across various socio-economic characteristics of the sample, we first check normality assumption for the dependent variable financial literacy. Shapiro Wilk normality test rejected the null hypothesis (p = 0.000) that the variable follows a normal distribution. Therefore, we use non-parametric tests such as Mann Whitney U Test or Wilcoxson Rank Sum Test to examine whether a significant difference exist between financial literacy groups by gender and marital status (Table-4), and Kruskal Wallis Test to examine whether a significant difference exist between financial literacy groups by age, education, employment, and income (Table-5).

Gender wise classification of financial literacy levels shows that of 75 respondents in the low financial literacy group, 80 per cent are male and 20 per cent female. Likewise, 84 per cent of respondents in high financial literacy group are male and 16 per cent are female. We see that most men and women belong to the low financial literacy group. There exists no significant difference in financial literacy between men and women.

Table-4: Percentage of Responses of Financial Literacy Groups by Gender and Marital Status and Results of Mann Whitney U Test

Sample Characteristics	Financial literacy		W	p value
	Low	High		
Gender				
Female	15 (20)	7 (15.56)	1003	0.568
Male	60 (80)	38 (84.44)		
Marital Status				
Single	7 (9.33)	2 (4.44)	417	0.3299
Married	68 (90.67)	43 (95.56)		

Source: Primary Survey

Percentage is shown in parenthesis

Classification of financial literacy groups by marital status shows that 90.67 per cent of respondents in the high financial literacy group are married, and 9.33 per cent are single. Similarly, in the low financial literacy group, 96 per cent respondents are married, and 4 per cent are single. However, there exists no significant difference in financial literacy levels of married and single respondents.

Kruskal Wallis test was used to examine the significant difference between financial literacy groups across age, education, employment and income. There exists no significant difference in financial literacy levels between the young, middle aged, and old age investors. Similarly, financial literacy levels does not hold a significant difference across different employment categories as well as annual income levels. However, Kruskal

Wallis test indicate a significant difference in financial literacy groups across graduates, post-graduates, and doctorates.

Table-4: Percentage of Responses of Financial Literacy Groups by Age, Education, Employment and Income and Results of Kruskal Wallis H Test

Sample characteristics	Financial Literacy		H	p value
	Low	High		
Age				
18-35	17 (22.67)	12 (26.67)		
36-55	34 (45.33)	23 (51.1)		
56 and Above	24 (32)	10 (22.2)	1.3218	0.5164
Education				
Graduation	31 (41.33)	10 (22.22)		
Post-graduation	43 (57.33)	32 (71.11)		
Doctorate	1 (1.33)	3 (6.67)	6.2086	0.04486*
Employment				
Government sector	7 (9.33)	6 (13.33)		
Private sector	28 (37.33)	16 (35.56)		
Self-employed	24 (32)	16 (35.56)		
Business	3 (4)	1 (2.22)		
Retired	10 (13.33)	5 (1.11)		
Other	3 (4)	1 (2.22)	1.1808	0.9467
Annual income				
Less than 5 lakhs	10 (13.33)	3 (6.67)		
5-10 lakh	21 (28)	14 (31.11)		
10-15 lakhs	13 (17.33)	10 (22.22)		
15-20 lakhs	11 (14.67)	4 (8.89)		
20-25 lakhs	7 (9.33)	3 (6.67)		
Above 25 lakhs	13 (17.33)	11 (24.44)	3.2726	0.658

Source: Primary survey
Note: 1. *significant at 5%
2. Percentage is shown in parenthesis

Behavioural Biases of Individual Investors

In this section, we examine the presence of six prominent biases, viz., representativeness, anchoring, availability, overconfidence, herding, and disposition effect. Representativeness, anchoring, and availability are chosen from heuristics theory, and overconfidence, herding, and disposition effect are chosen based on their presence in existing studies. Cronbach alpha test of reliability of the scale is shown in Table-5. The Cronbach's alpha being 0.8 indicates the good reliability of the instrument being used.

Table-5: Reliability Test Result

Scale	Cronbach's Alpha	No. of Items
Behavioural biases	0.8	22

Source: Primary survey

Each biases' presence is determined and ranked based on their mean score. Biases whose mean score is three and above indicates a strong presence, and those below three indicates a weak presence in the sample (Adil et al., 2022; Baker et al., 2018). Accordingly, five biases have a mean score above 3 which indicates their widespread presence among the stock market investors. Anchoring ranks first with the highest mean score of 3.58, followed by representativeness with a mean score of 3.5, and overconfidence with a mean score of 3.2. Availability bias ranks fourth with a mean of 3.16, and disposition effect ranks fifth with a mean score of 3.12. Since the mean score of herding bias falls below three, it is excluded from further analysis.

Table-6: Behavioural Biases of Stock Market Investors

Behavioural Biases	Mean	Rank
Representativeness	3.5	2
Anchoring	3.58	1
Availability	3.16	4
Disposition effect	3.12	5
Overconfidence	3.20	3
Herding	2.82	6

Source: Primary survey

The overall bias scale of 18 items (excluding herding bias) takes the lowest value 1 and highest value 90. Based on median score (M=59), respondents are further classified into high bias group whose median bias score is more than 59, and low bias group whose median bias score is less than or equal to 59. Thus, 47.5 per cent respondents fall in the high bias group, and 52.5 per cent respondents fall in the low bias group. In other words, majority respondents exhibit low levels of behavioural biases.

Table-7: Result of Mann Whitney U Test for Financial Literacy by Groups by Behavioural Biases

Variables	W	p
Financial literacy by:		
Overall Behavioural Biases	2058	0.1006
Representativeness	1672	0.4535
Anchoring	1672	0.4266
Availability	1548	0.2515
Disposition effect	1378	0.03072*
Overconfidence	2127	0.03022*

Source: Primary survey

Note: *significant at 5%

We further analyze whether financial literacy differs across five behavioural biases as well as the overall bias score (Table-7). There exists significant difference in financial literacy levels across disposition effect

(p=0.03) and overconfidence bias (0.03). Financial literacy does not show a significant difference across representativeness (p=0.45), anchoring, (p=0.43) availability bias (0.25). Besides, financial literacy levels does not show a significant difference across high and low bias group of investors (p = 0.1).

Table-8: Investor Types Based on Financial Literacy and Behavioural Bias Level

Financial literacy	Behavioural biases	
	High Biases	Low Biases
High financial literacy	17 (14.17)	40 (33.33)
Low financial literacy	28 (23.33)	35 (29.17)

Source: Primary survey

Note: Percentage is shown in parentheses

We further classify the investor into four types based on their levels of financial literacy and behavioural bias scores ascertained above. This helps us to understand how financial literacy levels and bias levels of stock market investors differ within the sampled group. The four types of investors identified are presented in Table-8. Type 1 investors have high financial literacy and high biases and accounts for 14 per cent of the sample. Type 2 investors possess high financial literacy and low biases, and account for 33 per cent of the sample. Type 3 investors are characterised by low financial literacy and high biases, and accounts for 23 per cent of the sample. Type 4 investors comprising 29 per cent are characterised by low financial literacy and low biases. Thus, we may understand that majority of the stock market investors belong to the ideal category of type 2 with high financial literacy and low behavioural biases.

Conclusion

Empirical studies on financial literacy and biases have gained prominence in behavioural/financial economics literature in India in the recent time. Usually, these studies examine the relationship between financial literacy and behavioural biases of retail investors, and their differences across various socio-economic characteristics (e.g. Baker et al., 2018), or use financial literacy as a moderating variable in investment decision (e.g. Adil et al., 2022). The objective of this paper is to examine the financial literacy levels, and presence of prominent behavioural biases among the individual investors in the context of Kerala, and whether it differs across sample characteristics. Further, based on the level of financial literacy and extent of biasedness, we classify the sample into four categories of investors.

Using primary data, we found that the overall financial literacy levels of the sample of individual investors is high at 66.8 per cent. But 75 per cent of them falls under the low financial literacy group. Among six biases chosen based on theory and empirical studies, five of them-representativeness, availability, anchoring, disposition effect, overconfidence – were present among the investors. Herding bias had a weak presence, hence was omitted from further analysis. When overall bias score was considered, 52.5 per cent fall under the low bias group.

Among various socio-economic factors considered in the study, financial literacy groups showed significant difference with respect to education, while age, gender, marital status, employment, and annual income were insignificant. On further analyzing the statistical significance of the difference in financial literacy across various behavioural biases, two of the five biases under consideration-disposition effect and overconfidence bias- were significant. Financial literacy groups did not show a significant difference across overall bias scores. Most of the respondents belong to type 2 investors characterized by high financial literacy and low behavioural biases.

This study hopes to add to the existing literature on the relationship between financial literacy and behavioural biases in the India, particularly from Kerala, which accounts for limited number of works on this area. The study throws some interesting insights. Kerala being the most literate state in India, has overall high financial literacy. However, their knowledge of advance stock market concepts needs improvement. To account for the heterogeneity in the overall financial literacy score, we checked the presence of high and low financial literacy investors, which showed most fell in the latter category. This study is important to policy makers and investment professionals to identify specific investor types and offer tailor-made advises to the respective groups and assist them towards realizing their financial objectives. The study also helps individual respondents to be aware of their financial literacy and psychological framework thereby helping them to better their understanding of stock market investment, especially behavioural investing.

Notes

1. The survey was conducted in the Ernakulam district of Kerala during January-February 2023. The district is home to Cochin Stock Brokers Limited (CSBL), a subsidiary of an erstwhile regional stock exchange known as the Cochin Stock Exchange.

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Agrarian Communities and Climate Change Vulnerability Analysis: Kerala State Insights

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Abstract

This paper attempts to analyses the Climate Change vulnerability and agrarian communities in the state of Kerala. Of late this has gained currency since climate change has become a preoccupation of not only environmentalists but also economists, politicians and corporates as well. All districts in Kerala and agrarian communities are scanned to find out climate change vulnerabilities. The following five distinct sub-indicators – sociodemographic, agricultural, occupational, common property resource (CPR), and climate condition – are used to analyze climate change sensitivity. The study attempts to create a comprehensive vulnerability index in order to appreciate the sensitivity to climate change and its effects on rural populations in Kerala. Finally, the study found that two districts are in High vulnerability category while eleven districts are in High Middle vulnerability category. On the other hand, there is one district in Low Middle and low vulnerability category in 2001. By 2011, eleven districts found to be High middle vulnerability category. On the others hand, there are three districts are to be found in Low Middle and low vulnerability according to composite index.

Introduction

One of the most important areas of the Indian economy is agriculture. With a contribution of around 14%, agriculture and related industries are the single largest contributor to India's GDP (Economic survey, 2015). Nearly 50% of the population is employed by the Farming Sector. Interestingly it happens to be one of the single largest private sectors to employ the

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work force. Furthermore, Indian Foreign Trade large share is owned by none other than the agriculture sector. Surprisingly agriculture accounts for about 14.7% of the total export earnings. According to 2011 census of India roughly 61% of Scheduled Castes (Dalits) and 79% of Scheduled Tribes (Adivasis) extensively depend on the agriculture. Most of them roughly 75% are agricultural laborers and the rest of 25% of Scheduled Castes and Schedule Tribes are cultivators (Census of India, 2011). Though the Marginal Land Holding percentage has increased to 73.17%, only 27.71% of the total operated area is under control. While small holding constitutes merely 15.30% of the total holdings and 23.44% of area operated under their control in the year 2012-13. On other hand, the number of medium holdings has been registered as 3.04% of the total holdings however the area under their control is confined to 19.33% of the operated area. Simultaneously large holdings have steadily declined to 0.36% of total holding but interestingly control has been registered to be 6.02% in 2012-13 (NSSO, 2012-13). Around this time Planning Commission has estimated the all-India level percentage of people below the poverty line to be 21.9% in 2011-12 (Govt. of India, 2013, p.2). At the same time population Census has declared that 68.86% percent of total population lives in the rural areas. Their livelihood is dependent on Agriculture. Unfortunately about 65% of India's cropped area is rain-fed. Ironically food production as well as economy is highly dependent on such unpredictable non-remunerative agriculture. It is very obvious that the whole economy of India in general and the rural poor in particular are directly affected by the climatic vulnerabilities inflicted on Agriculture. Hence, we could beyond doubt and second thought conclude that the erratic climate change makes agriculture vulnerable and the dependent rural poor as well as the economy. Such chain reaction negatively impacts food security, employment, and overall economic growth, health of the rural poor, education and even social security.

Climate Change's Effects on Agriculture

Climate change issues are numerous and complex. As a result, in recent years, everyone has become quite concerned about the effects of climate change. Weather instability, an increase in average temperature, unseasonably distributed rain, an untimely increase in the frequency and intensity of extreme weather patterns, melting of glaciers and snow, unheard-of floods and snowfalls, and a rise in sea levels are all effects of climate change. They are altering the ecological balance and natural ecosystems, which is upsetting some of the delicate industries that are integral to the human environment, such as forestry, fishery, water resources, and agriculture. Furthermore, these alarming shifts pose grave risks to human settlements, food security, livelihoods, and health. Today's experts link poverty to

ecological imbalance. There is rising concern and agreement among many voices that the poor and disadvantaged communities will bear the brunt of the cost of climate change since they are more vulnerable and have less capacity for adaptation because they lack access to the necessary resources (Herrmann, 2005).

South-West Monsoon dominates the Indian climate. The whole eco-system and humans extensively depend on the South-West monsoon. It is crucial because the timely South-West Monsoon determines whether there will be enough water for irrigation and drinking. If the monsoon is poor ground water table will not get recharged sufficiently. Catchment areas will not have stored water to be channeled to agricultural land. Today we have discovered that an insignificant disturbance in the sea somewhere in the corner of Latin America could adversely change the trajectory of South-West monsoon and agricultural productivity in Andhra Pradesh which is thousands of miles away. Two major climate-induced effects can negatively influence agricultural productivity. They are: There are two types of effects: direct effects, such as changes in temperature and precipitation of carbon dioxide, and indirect effects, such as changes in soil moisture and an increase in the frequency and distribution of insect and disease infestations. We do have proven records that such climate-induced effects have brought down considerably the yields of Rice and Wheat (IPCC 1996, 2001). Climate change induces physiological alterations which will debilitate the mother earth. Unfortunately agricultural production is vulnerable to such unwarranted variations. This may result either in excessive floods or droughts. Either floods or droughts will deficiently impinge on the socio-economic spheres of the society. India regrettably has not developed scientific, technological and administrative modules to predict forewarn impending dangers of climate change. Farmers have not been trained to maturely to cope with such imminent perils. It is high time that Indian Farmers in general, Andhra Telangana Farmers in particular are provided with complimentary inputs and institutional support and skills to cultivate resilience capacity to bounce back with ease

Today thanks to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change we have an access to huge amount of literature on the process of identification of adverse climate change. Climate change is surely a global environmental issue. It is associated with vulnerability and loss of biodiversity. The degree to which a system is sensitive to or unable to cope with negative effects of climate change, including climate variability and extremes, has been elegantly characterized as vulnerability (IPCC, 2001a). Climate related assessments are intertwined with physical, economic and social factors (Fussel, 2007). The Intergovernmental Panel on Climate Change (IPCC) defined vulnerability as “the extent to which

climate may damage or harm a system". It qualified that vulnerability invariably "depends not only on a system' sensitivity but also on its ability to adapt to new climatic conditions" (IPCC, 2000). A Study by Intergovernmental Panel has found out that vulnerability has a link with climate change. It is region specific and dependent. It varies to a great extent on its wealth, and that of poverty limits and adaptive capabilities (IPCC, 2000). Further, they have concluded that socio-economic systems of developing countries are more susceptible to climate and changes and vulnerabilities (Watson et al. 1996: 24). Degree of vulnerability varies from country to country; region to region; economic sectors to economic sectors and social groups to social groups (Bohle et.al., 1994). This is a result of the uneven distribution and pattern of the global climate Impacts, adaptive capacity, and vulnerability will all differ even though vulnerability varies widely among places (IPPC, 2001, P-48). Studies have shown that due to climate change, particularly through higher extremes and temporal/spatial shifts, food security in Africa has gotten worse than anyone could have imagined (IPCC, 2001). After several decades of experience and research the experts have predicted that in Indian too we will have flash floods or worse drought conditions due to globally undue increase in the average temperature changes in the range of 2.33 °C to 4.78 °C because of heavy CO_2 concentrations (Watson et.al, 1998). At the district level, Rao et al. (2013) conducted a scientific investigation and analysis of agriculture's susceptibility to climate change and fluctuation. This is so because most development planning and program execution in India takes place at the district level. At the district level, it is also possible to acquire the majority of the non-climatic data required to evaluate a region's susceptibility to climate change and create an adaptation strategy. 572 rural districts have been subjected to the examination in accordance with data from the Indian Census of 2001. The study discovered that there were more opportunities to collect more rainwater in areas where yearly rainfall and the number of wet days had increased, which ultimately aided in raising crop productivity and yields. In order to stop the waste of overflows and surplus water and to minimize soil erosion, the study suggests that it is extremely necessary to rebuild rainwater collection structures and procedures. Wherever such efforts have been implemented there droughts have been positively faced. Such plans and strategies therefore will surely optimize crop yields and incomes of people. Then Indian will become a beacon hope and an example of climate resilient smart Agricultural state.

Climate resilience is very much interrelated to gender. A study by Iqbal et al, (2013) has ascertained that households with greater empowerment of the females are less vulnerable. Without human- and environmental-friendly policies, temperatures will rise, rainfall patterns will change,

and there will be more floods and droughts frequently (Samanthan and Somanathan, 2009). This will likely have a serious impact on rural populations, who won't be able to adapt to their changing geography. This study has extensively made use of both primary and secondary data. The primary survey has been conducted in 2009; covering 10 villages of north Bihar, which have been affected by the river Kosi floods in 2008. According to them though the state has provided immediate relief but has miserably failed to facilitate long-term adaptation.

Dev (2013) analyses the connections between the nature of human action as drivers of threats as well as opportunities for sustainable agriculture and better human development outcomes. The study discloses that the livelihood is more vulnerable in mountainous areas of Himalayas, arid and semi-arid areas of Pakistan and India, vast coastal areas in South, South-east Asia and pacific islands and forest areas in the region. Small Islands are extremely vulnerable due to high exposure of population and agricultural infrastructure to sea level rise (e.g. Maldives) and increased storms. Poor and vulnerable groups are women, children, indigenous people, coastal dwellers, mountainous population and island dwellers. Indigenous population forms the most vulnerable group due to climate change.

Impact of climate change on food security has been carried out by Chakrabarty (2016) in India. He has considered three dimensions such as availability, access, and absorption. He has very much relied on the secondary data. His study has corroborated the findings of Chakrabarty that the climate change adversely affects food security in complex ways vis-à-vis impacts on crops, livestock, forestry, fisheries and aquaculture etc. The study also has proposed adoption of sustainable agricultural practices and systematic address of urban food security, public health, provision of livelihood security and long-term relief and rehabilitation measures in the event of natural disasters. Perhaps the fourth dimension of food security viz., sustainability that requires temporal and seasonal understanding of vulnerability is missing in the argument though inferences on sustainable agriculture is discussed.

Ajay Kumar et al (2013) found that the adverse impact of climate change on the value of agricultural production and food grains indicates food security threat to small and marginal farming households. Furthermore, the econometric model estimation revealed that the food security index itself also gets adversely affected due to climatic fluctuations. M. Rajeevan (2016) discovered that the significant warming trends in surface air temperatures including night temperatures and extreme precipitation events. Rainfall does not prove any significant trends at All-India but there are significant regional trends and sub-seasonal rainfall. Further, the study also unearthed that the variations in monsoon rainfall and surface temperatures influence

the food grain production in the country. The climate model projections (based on IPCC AR5 CMIP5 models) revealed that surface air temperatures including night time temperatures are expected to further increase.

In 2001 Drine has examined the interaction between climate changes, agriculture and food security in the MENA region. His analysis too has based itself on secondary data from a balanced panel of 11 MENA countries over the period 1980-2007 namely Algeria, Egypt, Jordan, Mauritania, Morocco, Lebanon, Sudan, Syria, Tunisia, Turkey, and Yemen. The study has exposed the decreasing trend in agricultural performance due to obvious inefficiency and regress in productivity. Moreover changes such as lower precipitation and more extreme events, like droughts and heat waves too have played their contributory role in lowering agricultural performance in the region.

A study published in 2014 by Sridevi et al., in numerous regions of the four South Indian States of Andhra Pradesh, Karnataka, Tamil Nadu, and Kerala, the susceptibility to climate change was not only mapped but also studied. The study has established that the district of Adilabad in Andhra Pradesh, the district of Chamarajanagar in Karnataka, Thiruvarur district of Tamil Nadu and Kasaragod district of Kerala have been the worst vulnerable districts. On the other hand, the districts of Hyderabad, Belgaum, Thoothukkudi, and Kottayam have, respectively, been the least vulnerable in Andhra Pradesh, Karnataka, Tamil Nadu, and Kerala. From the literature it is very clear that climate change does impact agriculture, ecology, human beings, socio-economic system and gender. Hence, this present study intends to verify at in-depth level by transposing the indications to all the four corners of Kerala. Of course, the uniqueness of the study is that the study will incorporate besides spatial factors temporal characteristics to the analysis.

The current study makes an analytical attempt to determine the socio-economic effects of climate change and the state of Kerala's susceptibility index. The district level is where the analysis is done. A district's susceptibility is determined by how frequently extreme events like cyclones, hurricanes, and depressions occur. The performance of the various districts in Kerala will be systematically ranked and indexed. The index makes an effort to represent a whole spectrum of vulnerability by incorporating a large number of proxies. The study has focused specifically on five main sources of vulnerability, including the CPR, agricultural, occupational, and meteorological aspects. In the end, the study hopes to provide a composite indicator.

Data Sources

Kerala is the state chosen for this investigation. In this study, 21 indicators are used to create vulnerability indices for a certain time span between

2001 and 2011. Nine of these variables are linked to socio-demographic vulnerability, four to occupational vulnerability, four to agricultural vulnerability, and the remaining four to the vulnerability caused by the climate and CPR. The Directorate of Economics and Statistics government of Kerala collected and produced secondary data from a variety of sources, including the 2011 Indian population census, which covered socio-demographic, occupational, and agricultural indicators. The India Meteorological Department (IMD) provided the rainfall data. Often, markers of vulnerability include a country's socio-economic makeup and state of its economic system. We intend to develop a vulnerability score in numerous districts and ecosystems in southern Indian states that takes into consideration socio-demographic, occupational, agricultural, climatic, and CPR factors in order to better comprehend this. We created a composite vulnerability metric using these traits., as described in Sridevi et al. (2014).

Methodology for the Study

The estimation of the composite index in this study was done using the method below. The decision to use this strategy over alternative ones is already discussed in Sridevi et al. (2014).

Using a functional connection to normalize the indicators

It is important to note that the indicator values were adjusted using the following formula to accept values between 0 and 1 as part of the normalization procedure:

Step 1: For each ecosystem's indicator, the dimension index (xi) is calculated as:

$$X_{ij} = \frac{X_{ij} - MinX_i}{MaxX_i - MinX_i} \quad ...(1)$$

The index is calculated whenever an indicator has a negative association with vulnerability as:

$$X_{ij} = \frac{Max\ X_i - X_{ij}}{MaxX_i - MinX_i} \quad ...(2)$$

For example, when higher literacy lowers vulnerability, this is possible.

In this formula, Xij denotes the normalized value of the i^{th} vulnerability indicator, Xij denotes the indicator's value in the j^{th} block, and 'Min Xi' and 'Max Xi' denote the indicator's minimum and maximum values throughout the district.

Step 2: For each of the five categories of vulnerability – socio, demographic, climatic, agricultural and occupational, and CPR – determine an average index. The indicators for each category are simply averaged to get this result.

The formula for the Average Vulnerability Index (AVI) is
[Indicator 1 +. + Indicator J] / J ...*(3)*
Step 3: Using the algorithm below, total up all the weak points.

$$CVI = \frac{\left[\sum_{i=1}^{n}(AVI_i)^{\alpha}\right]^{1/\alpha}}{n} \quad ...(4)$$

Where *n* is he quantity of vulnerability-causing factors and. The vulnerability indices can be calculated for each time period and compared to determine how much the vulnerabilities have changed over time.

Functional Associations between Indicators and Vulnerability

Table-1 illustrates the functional relationship between the markers and susceptibility. This study covers five sun-indicators, including socio-economic and demographic, occupational, meteorological, CPR, and agricultural data.

It was discovered that the district's population density affected both its demographic vulnerability and, in turn, its overall susceptibility to climate change. It was thought that it was positively correlated with climate change vulnerability, i.e., that the vulnerability would rise as there were more people living in a certain square kilometer as a result of global warming.

Table-1: Relationship between Indicators and Vulnerability

Components	Indicators	Functional Relationship
Socio-Demographic Vulnerability index	a) Average HH Size	+
	b) Density of population (persons per sq. km)	+
	c) Percentage of female	+
	d) Growth of Population	+
	e) Percentage of SC Population	+
	f) Percentage of ST Population	+
	g) Percentage of Literacy	-
	h) Sex ratio	+
	i) BPL	-
Index of Occupational Vulnerability	a) % of Marginal workers	+
	b) % of Non-Workers	+
	c) % of cultivators	-
	d) % of agricultural workers	+
Index of Agricultural Vulnerability	a) Cropping intensity	-
	b) % of irrigation area	-
	c) % of Fallow land	-
	d) % of net sown area	-
Common Property Resources Vulnerability	% of CPR to TGA	-
	% of animal livestock to CPR	+
Climate change Vulnerability	a) Rain fall variation	+
	b) Drought area	+

Sources: Developed based on Sridevi et al (2014).

On the other hand, it was thought that there was a poor functional relationship between demographic vulnerability and overall vulnerability and the literacy rate. The population's capacity to adjust to both the negative effects of shocks and the opportunities they generate is demonstrated by the literacy rate. Additionally, it suggests the share of public spending that goes toward education, which denotes an investment in human capital.

Similar to this, the percentages of cropping intensities, total cropped area, and percent of rice cultivated area in the district, taken collectively as the agricultural indicators, were anticipated to have a detrimental effect on the district's vulnerability to climate change. The indicators, such as variations in yearly rainfall, were considered to be positively correlated with climate sensitivity. This suggested that the districts would become more vulnerable if the variability of these climatic variables increased.

Result and Discussion

Table-1 lists the approximately 14 districts in the state of Kerala for which socio-economic, occupational, agricultural, common property resource, and climate change district-level indicators of vulnerability have been calculated. Examining the degree of susceptibility for other districts separately might be interesting.

Table-1: Districts-Wise Socio-Demographic Vulnerability Index Among Different Districts in Kerala

Districts	2001		2011	
	Values	Rank	Values	Rank
Alappuzha	0.17586	8	0.42238	9
Ernakulam	0.01035	13	0.38968	10
Idukki	0.23897	4	0.34798	12
Kannur	0.17698	7	0.37844	11
Kasaragod	0.22438	5	0.44716	8
Kollam	0.0981	10	0.46282	6
Kottayam	0.0203	12	0.32345	13
Kozhikode	0.00555	14	0.64215	1
Malappuram	0.2595	3	0.47994	4
Palakkad	0.34195	1	0.54582	2
Pathanamthitta	0.18868	6	0.25293	14
Thiruvananthapuram	0.0714	11	0.51949	3
Thrissur	0.16644	9	0.46636	5
Wayanad	0.29547	2	0.44743	7

Source: 1. Census of India, 2001 and 2011
2. Directorate of Economics and Statistical Organization of Kerala
3. Meteorology Departments of India

Table-1 presents the Districts Wise Socio-Demographic Vulnerability Index among different districts in Kerala. In terms of socio-economic risk, the district of Palakkad was found to be in the lead while the district of Kozhikode was on the bottom spot in 2001. In 2011, The district of Pathanamthitta was found to be in last place, with the district of Malappuram taking the top spot. The vulnerability indices for the same time period range from 0.265 to 0.621.

Table-2: The Occupational Vulnerability Indices by District in Kerala

Districts	2001		2011	
	Values	Rank	Values	Rank
Alappuzha	0.349	8	0.519	3
Ernakulam	0.455	5	0.488	11
Idukki	0.343	9	0.488	11
Kannur	0.342	10	0.514	4
Kasaragod	0.129	14	0.495	10
Kollam	0.484	4	0.496	9
Kottayam	0.301	11	0.48	13
Kozhikode	0.398	7	0.511	5
Malappuram	0.636	2	0.507	7
Palakkad	0.697	1	0.589	1
Pathanamthitta	0.292	12	0.481	12
Thiruvananthapuram	0.531	3	0.51	6
Thrissur	0.407	6	0.497	8
Wayanad	0.208	13	0.54	2

Source: 1. Census of India, 2001 and 2011
2. Same as in Table-1

According to Table-2, the district of Kasaragod placed lowest in 2001 whereas the district of Palakkad placed first. As far as occupational vulnerability is concerned, by 2011, Kottayam was ranked bottom while Palakkad was ranked first. During the same time frame, vulnerability indices had values ranging from 0.480 to 0.589.

Table-3: The Agricultural Vulnerability Index for Each District in Kerala

Districts	2001		2011	
	Values	Rank	Values	Rank
Palakkad	0.6779	1	0.5056	7
Alappuzha	0.1779	14	0.7525	1
Ernakulam	0.5057	5	0.4641	10
Idukki	0.4824	6	0.4373	11
Kannur	0.3724	8	0.5386	5

Districts	2001		2011	
	Values	Rank	Values	Rank
Kasaragod	0.3665	9	0.5395	4
Kollam	0.2789	11	0.5021	8
Kottayam	0.5814	2	0.4729	9
Kozhikode	0.4299	7	0.4036	12
Malappuram	0.2073	13	0.2141	14
Pathanamthitta	0.2485	12	0.5767	3
Thiruvananthapuram	0.5158	4	0.5098	6
Thrissur	0.5750	3	0.6443	2
Wayanad	0.3617	10	0.3991	13

Source: 1. Census of India, 2001 and 2011
2. Same as in Table-1

Table-3 shows the districts-Wise Agricultural Vulnerability Index for the various districts in Kerala. The district of Alappuzha was ranked last in the state in 2001, while the district of Palakkad earned the highest ranking. By 2011, the district of Palakkad held the lowest rank in the State and the district of Ernakulam maintained the highest position in terms of the agricultural vulnerability index. The vulnerability index values were in the range of 0.214 to 0.752.

Table-4: Districts-Wise CPR Vulnerability Index Among Different Districts in Kerala

Districts	2001		2011	
	Values	Rank	Values	Rank
Idukki	0.8922	1	0.4739	9
Alappuzha	0.1941	11	0.4053	10
Ernakulam	0.6743	4	0.3057	13
Kannur	0.3117	10	0.511	6
Kasaragod	0.1333	12	0.8152	3
Kollam	0.4692	8	0.383	11
Kottayam	0.5817	6	0.1808	14
Kozhikode	0.4385	9	0.5043	7
Malappuram	0.6908	3	0.5169	5
Palakkad	0.4945	7	0.6671	4
Pathanamthitta	0.1142	13	0.9348	2
Thiruvananthapuram	0.6732	5	0.5001	8
Thrissur	0.8078	2	0.3498	12
Wayanad	0.0661	14	0.9589	1

Source: 1. Census of India, 2001 and 2011
2. Same as in Table-1

Table-4 provides an explanation of the districts-Wise CPR Vulnerability Index for the various districts in Kerala. Wayanad was discovered to be in last place in 2001, with Idukki district holding the top position in the

State. According to the state's 2011 index measuring the vulnerability of its common property resources, Wayanad district came in first and Kottayam district came in last. The vulnerability index values were in the range of 0.180 to 0.958.

Table-5: The Climate Vulnerability Indices for Each District in Kerala

Districts	2001		2011	
	Values	Rank	Values	Rank
Alappuzha	0.3459	7	0.7782	2
Idukki	0.9143	2	0.8547	1
Kannur	0.3527	6	0.4809	8
Kasaragod	0.5715	5	0.5715	4
Kollam	0.2929	10	0.2464	13
Kottayam	0.5790	4	0.5261	5
Kozhikode	0.2697	11	0.4038	9
Malappuram	0.3414	8	0.5016	7
Palakkad	0.0000	14	0	14
Pathanamthitta	0.3314	9	0.3336	12
Thiruvananthapuram	0.1286	13	0.335	11
Thrissur	0.6790	3	0.76	3
Wayanad	0.1581	12	0.5161	6

Source: 1. Census of India, 2001 and 2011
2. Same as in Table-1

According to Table-5, the district of Ernakulam received the highest ranking in 2001, while the district of Palakkad received the lowest ranking. Idukki district was ranked first while Kollam district was ranked worst in 2011 according to the climate change risk index. Vulnerability indices ranged in value from 0.246 to 0.854.

We shall now look at the vulnerability composite indices developed for each district in Kerala. The 22 factors that make up the composite indices of vulnerability comprise CPR, agricultural and meteorological, and sociodemographic and occupational indicators. Table lists the district rankings as well as the composite vulnerability indexes. The rankings of the districts are based on vulnerability indexes.

Table-6: Indices of Composite Vulnerability Index among Different Districts in Kerala

Districts	2001		2011	
	Values	Rank	Values	Rank
Alappuzha	0.23608	10	0.448748	11
Ernakulam	0.27204	7	0.538062	3
Idukki	0.50302	1	0.46009	10
Kannur	0.30114	4	0.461307	9
Kasaragod	0.24053	9	0.560989	1
Kollam	0.28311	5	0.41076	12

Districts	2001		2011	
	Values	Rank	Values	Rank
Kottayam	0.26039	8	0.374984	13
Kozhikode	0.16219	13	0.479978	6
Malappuram	0.38139	3	0.50105	5
Palakkad	0.00000	14	0	14
Pathanamthitta	0.22026	11	0.465574	7
Thiruvananthapuram	0.27903	6	0.468728	8
Thrissur	0.46335	2	0.524509	4
Wayanad	0.18759	12	0.544202	2

Source: 1. Census of India, 2001 and 2011
2. Same as in Table-1

The most vulnerable district is shown by rank 1 in Table-6, and as we move up the ranks, the vulnerability lessens. In 2001, the district of Palakkad was discovered to be in last place, with the district of Idukki occupying the top spot in the State. By 2011 The district of Kasaragod in the state of Kerala is the one that is most at risk. Kottayam is the least vulnerable district in Kerala, according to the state's composite vulnerability index. The composite vulnerability index had a range of 0.375 to 0.560.

Changing Scenario of Vulnerability Over the Decades in Kerala

In order to captured the districts having high, high middle, low middle and low vulnerability category. For this purpose, the simple values of the districts on the basis of composite index of vulnerability are sufficient. However, more significant classification different stages of vulnerability can be obtained on the basis of Mean and S.D of composite vulnerability indices. The classification follows like this:

High Vulnerability: The districts having the composite indices greater than or equal to (Mean + SD).

High Middle Vulnerability: The districts having composite indices in between (Mean) to (Mean + SD).

Low Middle Vulnerability: The districts having the composite indices in between (Mean - SD) to (Mean).

Low Vulnerability: The districts having the composite indices less than or equal to (Mean - SD).

Table-7: Different Stages of Vulnerability Among Different Districts in Kerala According to Composite Index

Stages of Vulnerability	2001	2011
High vulnerability	Idukki and Thrissur	-

Stages of Vulnerability	2001	2011
High Middle vulnerability	Alappuzha, Ernakulam, Kannur, Kasaragod, Kollam, Kottayam, Kozhikode, Malappuram, Pathanamthitta, Thiruvananthapuram and Wayanad	Alappuzha, Ernakulam, Kannur, Kasaragod, Kozhikode, Malappuram, Pathanamthitta, Thiruvananthapuram, Thrissur, Wayanad, Idukki
Low $ Middle vulnerability	Pallakada	Pallakada, Kollam, Kottayam

Source: 1. Census of India, 2001 and 2011
2. Same as in Table-1

Table-7 exhibits the Different Stages of vulnerability among different districts in Kerala according to Composite index. As par composite index, two districts are in High vulnerability category while eleven districts are in High Middle vulnerability category. On the other hand, there is one district in Low Middle $ low vulnerability category in 2001. By 2011, eleven districts found to be High middle vulnerability category. On the others hand, there are three districts are to be found in Low Middle $ low vulnerability.

Conclusion

According to the study shown above, the district of Palakkad was found to be in last place in 2001, while the district of Idukki held the top spot in the State. Kasaragod district in Kerala is the area that is most vulnerable as of 2011. According to Kerala's composite vulnerability index, Kottayam is the district that is least vulnerable. The range of the composite vulnerability indices was 0.375 to 0.560. As par composite index, two districts are in High vulnerability category while eleven districts are in High Middle vulnerability category. On the other hand, there is one district in Low Middle $ low vulnerability category in 2001. By 2011, eleven districts found to be High middle vulnerability category. On the others hand, there are three districts are to be found in Low Middle $ low vulnerability.

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Infrastructure and Economic Development: Some Empirical Evidence

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Abstract

Economic development is a process whereby the productive capacity of the economy raises over a period of time. This development process will result in raising levels of output and income. There are various determinants to development, one of them is infrastructure. This paper attempts to study the impact of two infrastructural components i.e., power consumption and air transport. Using multiple regression the paper finds that both variables power consumption and air transport have a significant impact on economic development.

Introduction

Economic development in the present scenario involves providing productive work to all. It includes enhancing and improving the quality of lives in an environmentally and socially sustainable ways. Appropriate policies have to be thoroughly implemented in order to achieve the goal of sustainable development. The main obstacles in the implementation of these policies are distributional issues and inherent weaknesses in institutions. Efficient institutions balance the interests of different stakeholders. They also pick up the relevant signals which are conducive to development and put in efforts and methods in place to execute the decisions which boost growth.

It is a well-known fact that increasing productivity and incomes contribute to high economic growth. It is also evident that economic development not only includes growth but other economic and non-economic factors. For economic development to take place, transformation of the society and the social structure is crucial. In addition to this, management of environmental issues plays a vital role in promoting sustainable development. An integrated approach of social transformation and environmental protection

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has to be adopted along with steps to promote economic growth. Unless this approach is adopted, growth will be jeopardized and development cannot be sustainable in the long run.

Experience suggests that not addressing social and environmental issues along with economic factors results in irreversible consequences in the long run. The process of development is a long term one, because it involves changes in attitudes and institutional framework. To determine the pace and diversity of economic development another crucial factor is physical and social infrastructure. "Infrastructure includes the underlying amount of physical and financial capital embodied in roads, railways, waterways and airways, financial institutions, electricity and public services such as health and education.

Economic development is closely related to industrial development. This in turn depends on infrastructure facilities. It is evident that the increase in production and productivity of the industrial sector not only depends on machinery and equipment, but also energy – electricity, coal, petroleum, crude oil, natural gas. Infrastructure also consists of transport at communication facilities. The enhancement of these facilities will aid industrial growth and overall economic development.

It is a widely known fact that higher levels of energy use lead to improved GDP levels. The use, accessibility and affordability of energy have a strong bearing on higher development levels. Without higher levels of improvement in energy infrastructure it is difficult for an economy to attain development. Higher consumption levels of energy lead to improved levels of development. Before industrial revolution economies were dependent on availability of organic energy sources like fire wood, man power and horse power. In the 21st century with new innovations and technological progress new energy sources other than conventional sources like coal have come into existence. In the context of sustainable development clean and affordable energy is now crucial. This will not only lead to increase in production but also will have a positive impact on people's lives and health. Clean energy sources can unlock the possibilities of exponential production and growth. Investment in energy infrastructure will directly and indirectly lead to growth.

Electricity is a key factor of production because it is not substitutable with other factors; non-availability of electricity for firms and other business units will constrain output. Proper use of electricity will speed (accelerate) up the process of production. Consumption of electricity will directly improve the wellbeing of the household in various ways. In the modern time all the consumer durables like washing machine, robots etc. will make the lies of the consumers comfortable. The usage of consumer durables powered by electricity will save time and improve efficiency of

the individuals and therefore and giving more time for production work. The modern communication devices like internet revolutionize the modern man's life in every walk of life by saving the time and money.

It has brought in a revolution in various sectors and new business activities have sprung up with the advent of electricity. The heavy machinery or the smallest devices used in production always require power. Without power the production cannot happen. Every household requires electricity for the day today activities. Power is crucial for computers, internet communications. The service sector like banking, insurance, health, everything depends on electricity for functioning. From e-commerce, e-payments to a small vendor and individual consumer, without power life will not move ahead. This study tries to find out the impact of power consumption on growth.

Air transport occupies an important place and plays a crucial role in the process of economic development. Improved air transport also acts as a catalyst for connectivity between regions and nations which will improve the domestic growth of the country and also makes the country successful at the global level. Since air transport is the most efficient and fastest way of moving goods and people which will help and contribute to economic progress. Air travel has brought in a sea change in the movement of people and goods from one place to another.

Air transport brings about massive connectivity which will result in improvement in trade and greater cultural exchange and also improvement in tourism. This increase in connectivity accelerates expansion in economic activity and prosperity. The relation between air transport and economic development is multifaceted. Air transport brings together distant regions through faster movement of people and products. The air transport connectivity helps the business community to access new markets and consumers which will lead to not only profits for the businesspeople but also improved international trade thereby helps the countries to earn more foreign exchange. Through air transport we can enable the timely delivery of goods especially perishable items. This fast movement of goods strengthen the global supply change.

Review of Literature

Rudra P. Pradhan, Neville R. Norman et al (2013) attempts to understand the relationship between transport, FDI and growth. For this study ARDL and VECM models were used. The results depicts that transport infrastructure is co-integrated with FDI and growth. As for the causality of variables studied the results show that between transport and FDI there was bidirectional causality. In addition to this it was also concluded that between transport and GDP and FDI and GDP there was bidirectional causality. Since the Study finds a clear causality between transport infrastructure and FDI, improvement in the transport infrastructure can lead to increased FDI.

It is also clear by the Study that improvement in transport infrastructure will accelerate GDP growth.

Rudra P. Pradhan et al (2013) studies the impact of transport infrastructure on economic growth. The period of Study was 1970-2010. The method used for the study was Vector error correction model. It was found that between transport infrastructure and growth there was bidirectional causality. The results depict that between road transport and capital formation, GDP and capital formation there was a bidirectional causality with respect to some variables such as rail transport and growth, rail transport and gross capital formation the results showed a unidirectional causality. The authors recommend that for a significant economic growth improving transport infrastructure and accelerating gross capital formation is necessary.

Anitha Kumari et al (2017) attempts to evaluate the impact of physical and social infrastructure on development. The study period was 1995 to 2013. To examine the stationarity of the variables Augmented Dickey Fuller and Phillips Perron unit root test were used. In order to estimate the causality unrestricted VAR model and Granger Causality tests were used. The authors conclude that physical and social infrastructures have a positive impact with economic growth.

Tassew Dufera Tolcha et al (2020) examines whether air transport demand leads economic development or development leads to increase in demand for air transport. The paper analyses the causal relationship between air transport and development for six Sub-Saharan African countries. The study period was 1981-2018. The methods used were Vector Error Correction and Vector Auto regression models The paper tries to analyse the short run and long run causality. It was found that the causal relationship was context specific and heterogeneous. In the long run the causality for south Africa, Nigeria and Kenya was found to be from economic development to air transport demand. For Ethiopia a rise in the demand for air transport resulted in economic development. For countries like Senegal and Angola there was a very weak causal relation.

Aviral K Tiwari et al (2021) studied the causal relationship between power consumption and economic growth for the period 1961 to 2015. Tests like panel integration tests with structural breaks and panel VAR based impulse response model was used to understand the relationship. The author concludes that there was a long run relationship between economic growth and power consumption. At the state level unidirectional causality was observed between electricity consumption and growth. In the agricultural sector between power consumption and growth a unidirectional causality was recorded.

Yogita Shamdasani (2021) estimates the effect of improvements in infrastructure on production decisions in agriculture. The paper finds that the households which have access to roads diversify their crop portfolio.

Evidence also showed that households which have infrastructural facilities (rural roads) also take up modern agricultural practices. The findings also suggest that the access to roads increase the mobility of agricultural workers which integrates the labour markets, this in turn enables the adoption of labour intensive production.

Yijia, Llu Cheng (2023) attempts to understand the relationship between transport infrastructure and growth in UK. The period of study was 1972-2017. Using principal component analysis a measure of transport infrastructure development was estimated. The relationship both short run and long run between the variables was examined using VECM model. The results conclude that in the short run the effect of transport infrastructure on economic development is negative while in the long run there is a positive effect of transport infrastructure on development.

Coro Eduardo Bazan Navarro et al (2023) estimate the relationship between electric power consumption per capita and real GDP per capita in Peru for the years 1971-2014. Granger causality test was used to analyse the relationship. It was found that economic growth causes increase in electric power consumption. The paper also analyses and evaluates the investments in electricity generation, transmission etc. through renewable sources. The paper suggests that clean and green energy is necessary for power demand to be sustainable.

Quang Hai Nguyen (2023) studies the causality between air transport and growth for the various regions of Asian continent. The period of study was 1975-2019. Initially the Author examine the stationarity of the variables and also estimates the co integration. Then to understand the causality between air transport and growth granger causality test was used. In most of the regions of Asia, between air transport and growth a bi-directional causality was found. Uni-directional causality was found from economic growth to air passenger transport. In Central Asia the causality was unidirectional from economic growth to air freight.

Methodology and Results

The data was collected from world development indicators-world bank. The study period was 43 years (1972 to 2014). The dependent variable was GDP (y) and the independent variables were power consumption (x1), and air transport (x2).

Variable	Coefficient	St. error	t-statistic	P >|t |
X1	1.4576	0.0978	14.89	0.000
X2	0.0994	0.043	2.30	0.027

In order to understand the effect of power consumption and air transport on economic growth multiple regression technique was employed. The

dependent variable was GDP and the independent variables were power consumption and air transport. The coefficient for power consumption was 1.46 indicating that with 1 unit of increase in power consumption GDP will grow by 1.46%. The t-value was 14.89 indicating that power consumption is a significant variable which impacts economic growth (GDP). P value <o.5 shows that we have 5% level of significance. The second independent variable air transport had a coefficient value of 0.099, this indicates that 1 unit of change in air transport will bring about around 0.1%change in GDP. The t-value (2.30) indicates that air transport is a significant variable which has a positive impact on GDP. It is clear that the two infrastructure indicators power consumption and air transport have a positive and significant impact on economic growth.

Conclusion

This paper makes an attempt to analyse the effect of two important aspects of infrastructure on growth. The variables used were air transport and energy use. Using multiple regression method it was found that the two variables have a significant impact on the economic growth. Policy makers should focus on improving power consumption of the people and providing better air transport facilities which will have a definite impact on accelerating the growth process.

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