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Deconstructing Kerala's Growth Through Fiscal Analysis

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Abstract
Kerala, a state known for its social development achievements, has always been questioned about its sustainability. The state witnessed an average growth rate of 10.65% in the post-2010 period, despite facing the worst exogenous shocks since its formation. This study aims to analyze and decompose the factors that caused this growth by empirically analyzing Kerala's economic growth over the past 22 years using Multiple Regression Analysis and intense econometric analyses to provide better insights for better accuracy we choose to do computerized econometric analysis with the help of Machine Learning using Google Collab. Ultimately, this study evaluates the sustainability of fiscal structure growth by analyzing its nature. JEL Classification: H63, H68, E62, C32

Keywords: Public Debt, Economic Growth, Fiscal Decomposition

INTRODUCTION

Kerala Model-the economic development approach received huge praise for its top performance in its remarkable achievements in social development, which has always been a matter of study for economists due to its paradoxical nature. The annual GSDP of the state put it in the ninth position, while the poverty rate is below 1%, the global data lab had ranked Kerala topped in the HDI with 0.782 in 2021. The inclusive social development achievements despite lagging behind the economic indicators have been the subject of many studies and a topic for critique (Parayil, 2000; Tharamangalam, 2010; Sen, 1997). Many critiques have attributed the development of the state to the people rather than the government, they call out the development of Kerala as an outcome of public action or public politics (Franke and Chasin, 1992; Dreze and Sen, 1997; Kannan 1997)

Like any other model; there exist drawbacks to Kerala's development approach that intrigued the economists much more than others, as it violated much traditional development literature. Primarily, even when the state's economy is fast recovering from the exogenous shocks, the state's total debt has increased by 99.3% in the past 7-year period. Secondly, when the economy has a powerful IT sector that fuels the growth of the tertiary sector and in turn, the overall economic growth, the distress faced in the agricultural sector and the stagnated nature of the industrial sector are called into question (Nair, 2007; Varghese, 2020; Nair & Ramkumar, 2007; Subramanian 2000). Many critics have also argued about the quality of public expenditure, as it has exponentially risen in recent years (Abhinav, 2021; George 2003). The paradoxical condition that the state is facing both underemployment and unemployment despite the high

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educational level of the state has also been a concern for distress in the economy.
This study aims to provide an econometrically rigorous deconstruction of Kerala's economic growth using the past 22 years of data. Therefore this paper aims to bridge the literature gap by providing strong empirical evidence using a comprehensive set of variables. The data frame used in the study is taken from CAG report and State Budgets from 2000 to 2022.

Literature Review

Many studies have analyzed and examined the fiscal sustainability of subnational economies. (Raju, 2011) investigated the fiscal sustainability of the 14 Indian states including Kerala using the cointegration tests, the result was that primary revenue balance was the only variable indicating sustainability implying that the fiscal policy is unsustainable. This further builds up to another issue corroborated by (Raju, 2009) that the states with poorer fiscal performance will face a higher cost of borrowing as it significantly affects the state bond yield spreads.
Therefore, many studies including (Naidu, 2017; Das, 2015; and Chakraborty (2009) have challenged the state's growing reliance on debt financing and advocates for fiscal reforms for sustained debt levels. In a prior study (Das, 2015) thoroughly investigated the fiscal performance of three major states - Kerala, Punjab, and West Bengal have used the Johansen cointegration test over the past 40 years. There should exist a long-run comovement between revenues and expenditures for sustainability, and it was found that it is not strongly maintained for Kerala. Therefore the state does not satisfy the requirements to be tagged as fiscally sustainable. The study warned about the debt unsustainability of the state in the long run. Further building on this, (Lakshmanan, 2019) did the cointegration analysis first without accounting for structural breaks for the 50-year data set. This indeed confirmed Kerala's fiscal policy as unsustainable. It was found that Kerala's expenditure is rising faster than revenue, making it necessary for the state to rely on higher debt and interest costs, supported by (Jose, 2023).
Focusing solely on the debt sustainability of the Indian states, (Mohanty and Mishra, 2017) have examined if the fiscal policy of the states is procyclical during the 1999-2014 period. This study found a strong positive correlation between the output gap and fiscal indicators, resulting in the procyclicality of fiscal policies. This study further statistically proved that this induces fiscal stress and unsustainability in the long run. (Kubendran, 2018) has further proved that there exists a connection between state deficits and external fiscal imbalances. (Shastri and Giri, 2017) have calculated the debt threshold level of 4 Indian states including Kerala, and found that a debt threshold level of 27% for the state and anything further would influence the fiscal policy of the state this was further supported in the (Renjith, 2023; Rangarajan and Srivastava, 2005)
Additionally, (Thekkedath; 2023), statistically examined the state's public debt and found that there exists an inverted U-shaped relationship between economic growth and public debt. (Renjith, 2023) statistically proved that the debt threshold level at 27.8 and forecasted that if the state can aim for an average growth of 14%, along with a 3% fiscal deficit or a growth of 12 with a deficit level of 2.5%, the state could achieve this target by 2032

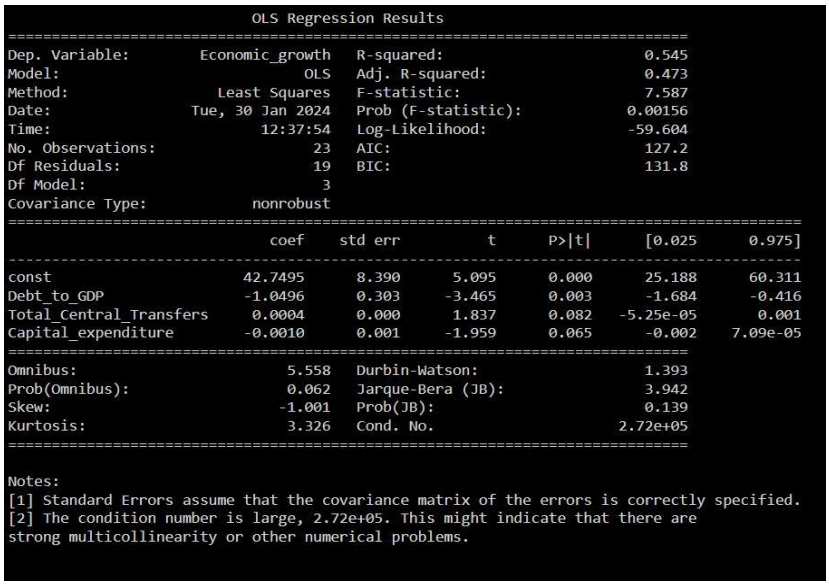
Analytical Framework[3]

This study provides a comprehensive econometric analysis using ML with the help of Google Collab. The

[3] The code used in study can be accessed via GitHub in the public repository named Dataeconomicgrowth

study primarily uses statsmodel,matplotlib, numpy, and pandas as the required libraries for the econometric analysis.

The study takes into account 5 major variables- Economic Growth, Debt to GDP, Total Central Transfers, and Capital Expenditure. Economic Growth is a dependent variable as a given endogenous growth theory links long-run determinants of growth (Romer,1994) and is measured as the annual percentage in real state GSDP (Solow, 1957), Capital Expenditure is taken as a variable in the study as the Wagner's law suggest that government expenditure helps the economic growth (Wagner,1911). Also, debt to GDP was found to affect economic growth after the threshold level (Reinhart and Rogoff, 2010),(Raju, 2011)(Krugman, 1988) also explores the relationship between debt to GDP and economic growth.



OLS Regression Results

Dep. Variable:	Economic_growth	R-squared:	0.545
Model:	OLS	Adj. R-squared:	0.473
Method:	Least Squares	F-statistic:	7.587
Date:	Tue, 30 Jan 2024	Prob (F-statistic):	0.00156
Time:	12:37:54	Log-Likelihood:	-59.604
No. Observations:	23	AIC:	127.2
Df Residuals:	19	BIC:	131.8
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	42.7495	8.390	5.095	0.000	25.188	60.311
Debt_to_GDP	-1.0496	0.303	-3.465	0.003	-1.684	-0.416
Total_Central_Transfers	0.0004	0.000	1.837	0.082	-5.25e-05	0.001
Capital_expenditure	-0.0010	0.001	-1.959	0.065	-0.002	7.09e-05

Omnibus:	5.558	Durbin-Watson:	1.393
Prob(Omnibus):	0.062	Jarque-Bera (JB):	3.942
Skew:	-1.001	Prob(JB):	0.139
Kurtosis:	3.326	Cond. No.	2.72e+05

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.72e+05. This might indicate that there are strong multicollinearity or other numerical problems.

Figure 1: OLS Regression Result Printed out using ML Timeframe: 2000-2022

This study has done OLS Regression using the stat model and panda libraries, the R square value came back to 0.545 which means that 54.5 percent of the variation in economic growth can be explained by the model here, the F statistic proves that the model can reject the null hypothesis. The change in variation causing economic growth was found as follows:

- A one-unit increase in Debt to GSDP can cause a decline of -1.04 units in the economic growth
- A one-unit increase in Total Central Transfers can cause an increase in economic growth by 0.0004 which is slightly above the p-value of 5 percent
- A one-unit increase in Capital Expenditure can cause a decline in economic growth by 0.0010 units

```
 Summary of Regression Results
==================================
Model:                 VAR
Date:         Fri, 02, Feb, 2024
Time:                13:45:49
--------------------------------------------------------------------
No. of Equations:      4.00000    BIC:               34.6465
Nobs:                 20.0000    Method:               OLS
HQIC:                 33.2041
Log likelihood:       -406.057    FPE:           2.44891e+14
AIC:                  32.8542    Det(Omega_mle):    5.53988e+13
--------------------------------------------------------------------
Results for equation Economic growth
==========================================================================================
                          coefficient    std. error       t-stat        prob
------------------------------------------------------------------------------------------
const                       -0.471796      1.244839       -0.379        0.705
L1.Economic growth          -0.478492      0.318770       -1.501        0.133
L1.Debt to GDP              -3.184258      0.661556       -4.813        0.000
L1.Total Central Transfers   0.000033      0.000356        0.092        0.927
L1.Capital expendityre       0.000756      0.000533        1.417        0.156
L2.Economic growth           0.063525      0.354609        0.179        0.858
L2.Debt to GDP               2.831164      0.765000        3.701        0.000
L2.Total Central Transfers  -0.000442      0.000398       -1.111        0.267
L2.Capital expendityre       0.000713      0.000480        1.485        0.137
==========================================================================================

Results for equation Debt to GDP
==========================================================================================
                          coefficient    std. error       t-stat        prob
------------------------------------------------------------------------------------------
const                        0.288688      0.536515        0.538        0.591
L1.Economic growth           0.112995      0.137387        0.822        0.411
L1.Debt to GDP               1.271642      0.285125        4.460        0.000
L1.Total Central Transfers  -0.000164      0.000153       -1.072        0.284
L1.Capital expendityre      -0.000248      0.000230       -1.077        0.281
L2.Economic growth          -0.043330      0.152833       -0.284        0.777
L2.Debt to GDP              -0.699535      0.329708       -2.122        0.034
L2.Total Central Transfers   0.000367      0.000172        2.142        0.032
L2.Capital expendityre      -0.000472      0.000207       -2.284        0.022
==========================================================================================

Results for equation Total Central Transfers
==========================================================================================
                          coefficient    std. error       t-stat        prob
------------------------------------------------------------------------------------------
const                     3383.692811   1186.300467        2.852        0.004
L1.Economic growth        -271.621679    303.779694       -0.894        0.371
L1.Debt to GDP            2257.629815    630.446430        3.581        0.000
L1.Total Central Transfers  -0.820311      0.339111       -2.419        0.016
L1.Capital expendityre      -0.076952      0.508332       -0.151        0.880
L2.Economic growth        -837.075073    337.933132       -2.477        0.013
L2.Debt to GDP            -628.863221    729.025171       -0.863        0.388
L2.Total Central Transfers   0.296023      0.379312        0.780        0.435
L2.Capital expendityre      -0.523107      0.457314       -1.144        0.253
==========================================================================================

Results for equation Capital expendityre
==========================================================================================
                          coefficient    std. error       t-stat        prob
------------------------------------------------------------------------------------------
const                     1657.699013    595.173457        2.785        0.005
L1.Economic growth         109.704786    152.407940        0.720        0.472
L1.Debt to GDP             768.528750    316.298435        2.430        0.015
L1. Total Central Transfers -0.134199      0.170134       -0.789        0.430
L1. Capital expenditure     -0.274313      0.255033       -1.076        0.282
L2. Economic growth       -584.758456    169.542907       -3.449        0.001
L2. Debt to GDP           -247.496370    365.755930       -0.677        0.499
L2. Total Central Transfers  0.009643      0.190303        0.051        0.960
L2. Capital expendityre     -0.831187      0.229437       -3.623        0.000
==========================================================================================

Correlation matrix of residuals
                    Economic growth  Debt to GDP  Total Central Transfers  Capital expendityre
Economic growth            1.000000    -0.326888                -0.576388            -0.742352
Debt to GDP               -0.326888     1.000000                 0.328185             0.324152
Total Central Transfers   -0.576388     0.328185                 1.000000             0.349371
Capital expendityre       -0.742352     0.324152                 0.349371             1.000000
```

Fig 2: Printed output of VAR Modelling

To further explore the dynamic interaction between multiple time series variables, this study uses Vector Autoregression, the code-typed instructions to check and handle stationarity in the data frame using the Augmented Dickey-Fuller test with the help of the adfuller library and the statsmodel is used for VAR Modelling. The statistically significant results printed out are:

- The economic growth equation reveals that lagged debt to GDP and capital expenditure is negatively related to economic growth.
- In the Debt to GDP equation, lagged debt to GDP has a positive relation with debt to gsdp
- The lagged debt to gsdp shows a positive correlation for the Total Central Transfers equation. Lagged transfers
- For the Capital expenditure equation, the lagged debt to GDP is negatively related.

To check the accuracy of the comprehensive econometric model created for the study, we used the data frame to create a short-term prediction for the years 2023-24 with the help of Arimax modeling and compared it with the government forecast. The government forecasted an 11.2% growth rate and our study forecasted a growth rate of 9.97%. The equations used in the forecast are as follows:

Economic_growth(t+1) = -1.3639306155042303 + 0.000384528309375002 * Economic_growth(t) + -0.0009651789539792283 * Debt_to_GDP(t+1) + 0.09266512934971613 * Total_Central_Transfers(t+1)

+ -0.3841935894620565 * Capital_expenditure(t+1)

```
Short-term Forecast:
23    9.979322
dtype: float64

Standard Errors:
23    3.331404
dtype: float64

Confidence Intervals:
    lower Economic_growth  upper Economic_growth
23               3.449891              16.508753
```

Figure 3: Arimax Short-term forecast printed out Dataframe: 2000-2022

Supplementary Analysis

To explore the interrelationship and temporal dynamics between the variables this study employs, the Vector Error Correction Model (VECM) uses a stats model using Johansen Cointegration.

The Augmented Dickey-Fuller Test proved the data is non-stationary, therefore the data frame was transformed using the Yeo-Johnson transformation, further, the test was done again on which the data frame was proved stationary. Further, the study did separately did the Johansen co-integration test for Economic Growth and the other 3 variables in the study.

	Economic Growth and Debt to GDP	Economic Growth and Total Central Transfers	Economic Growth and Capital Expenditure
Trace Statistic	38.85642093474695	32.603824079074734	13.652934869156345
Critical Value	1.0221315455856717	7.987766244124311	2.0082255987050197

Table 1: The printed output of the trace statistic and critical value

Further, the study conducted VECM Modelling similarly for the Economic Growth and the other 3 independent variables using the statsmodel library. The significant findings from the printed output of the analysis:[4]

Economic Growth and Capital Expenditure:

- The coefficients of lagged variables indicate a short-term relationship with the variables themselves i.e the past values affect the future values in the short term
- In the loading coefficient, in the equation for economic growth, the 'ec1' variable is 0.0008, giving a

[4] The printed output result of the VCEM Model is added in the appendices section

small contribution to the cointegration equation. In the equation for capital expenditure, the 'ec1' variable is 6,2852 suggesting a significant influence on the co-integration relation.

- The beta 1 value of 1 represents a unitary relationship and the beta 2 value suggests a relationship between the cointegration series

Economic Growth and Debt to GDP

- The coefficients of lagged variables indicate a short-term relationship with the variables themselves i.e the past values affect the future values in the short term.
- In Equation 'Economic growth' loading coefficient 'ec1' is -0.8702 indicating a negative cointegration relationship. In the equation 'debt to GDP' the loading coefficient 'ec1' is 0.0726
- The beta1 represents a coefficient of 1 which indicates a unitary relationship and the beta 2 value is -0.4531 i.e a long-term negative relationship
- Economic Growth and Total Central Transfers
- One unit increase in a lagged variable in Economic Growth is associated with an increase of 9.1299 in Total Central Transfers in the short term.
- In loading coefficients in the equation for central transfers, the error correction term is associated with a decrease of 37.0457 units to itself.
- The beta 1 value indicates a unitary relationship, and the beta 2 value of -0.0076 indicates a negative relationship in the long run.

Analysis and Discussion

This study aims to econometrically deconstruct and study the factors causing economic growth using the past data of 22 years. This study uses a secondary data combination of reports from CAG reports, budget reports, and also budget speeches. Further, based on empirical techniques like VAR, VECM, and ARIMAX modeling, the study found several significant findings. Firstly, Debt to GDP has a negative relationship with economic growth, i.e debt hampers economic growth. These findings corroborate the previous studies on fiscal sustainability (Reinhart and Rogoff, 2010),(Raju, 2011)(Krugman, 1988). Contradictory to Wagner's Law (Wagner, 1911), this study found out there is only a small positive impact on economic growth, and also capital expenditure affects economic growth negatively. The VAR modeling shows a negative relationship between lagged Economic growth and Debt to GDP as well as with capital expenditure. The VCEM Modelling further establishes this as a long-term relationship that supports the prior studies (Reinhart and Rogoff, 2010),(Raju, 2011)(Krugman, 1988) and also refutes. (Wagner, 1911). This long-term trend points to structural issues which if left unchecked can undermine the fiscal sustainability of the state (Mohanty and Mishra, 2017). However, this study has an inherent limitation in that it uses only 22 years of data and only 4 variables are extensively studied. As this study uses more static modeling, it fails to capture structural. In the absence of prudent fiscal reforms, the state may face a fiscal crisis long run, therefore the state should be astute in fiscal management to avoid it.

Conclusion

Kerala the southernmost state of India was once praised for its innovative way of development model popularly known as "Kerala Model of Development". It remained a puzzle for quite some time among economists about how the state was able to attain a high level of development in the social and economic sphere despite its low per capita income. Later it was found out this miracle achievement had its drawbacks

it was the huge remittance flowing into the state, especially from the Middle East that enabled this remarkable transformation in the state but the state pathetically failed to create enough employment for its educated youth forcing them to find their livelihood abroad Secondly, the state incurred heavy debt to roll out its capital expenditure project which put additional burden on future generation and also curtailed its borrowing capacity in future. In this paper, we tried to analyze the effectiveness of debt-driven capital expenditure done by the Kerala govt in the last 22 years and its impact on economic growth.

For the study following variables were used: GSDP, Capital Expenditure, Debt to GDP, and Total Central Transfers. We found out the debt, driven capital expenditure projects were not giving desired results, since it was unable to boost the economic growth of the state., from our findings we found out that the, lagged debt to GSDP ratio has a positive correlation with Central Transfers and at the same time the impact of Central Transfers was satisfactory as it was able to foster states economic growth. This finding points out great concern that Kerala is one of the states having a high Debt-to-GSDP ratio if the capital expenditure undertaken using this debt does not yield sufficient return this may lead to a huge financial crisis for the state because the lagged values of Debt to GSDP ratio was showing positive correlation to current year debt GDP level. The excessive dependence on central transfer to propel Kerala's economy is also not a good sign for the state. Kerala being a service-driven economy should explore its tourism potential as well as encourage private investment in the state by simplifying the regulations for starting new enterprises. The state should adhere to the FRBM Act and reduce its fiscal deficit and bring it down to a sustainable level in the medium term. It may be the fiscal mismanagement that led the state into this dire situation, a strategic planning is essential to help the state to escape from this deadlock.

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