Dynamic interaction between savings, investment and economic growth in India: Evidence from ARDL approach

Liya Varghese
Research Scholar, Department of Applied Business Economics
Dayalbagh Educational Institute, Agra-282005
Email Id: liya190983@dei.ac.in

Dr. Swami Prasad Saxena
Professor, Department of Applied Business Economics
Dayalbagh Educational Institute, Agra-282005
Email Id: spsaxena@dei.ac.in

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Abstract: *The study of economic growth, savings and investment has been a cornerstone of macroeconomic analysis due to its central role in fostering long-term development and stability. This paper aims to address the issue by investigating the relationship between savings, investment, and economic growth in India using annual time series data spanning from 1991-92 to 2022-23. The study applies the Autoregressive Distributed Lag (ARDL) model to test cointegration and utilizes Error Correction-model to explore short run dynamics. Granger causality test is used to explore the causal connections between the variables. Findings of the study indicate a long-term cointegration between savings (GDS), investment (GFCF), and economic growth (GDP) when alternatively, each variable is taken as the dependent variable. The results of ECM revealed no short run impact of GDS and GFCF on GDP, but GDP has short run impact on both savings and investment. The Granger causality test concludes with bidirectional causality between investment and GDP. However, no causality is observed between GDS and GDP, and GDS and GFCF. The study suggests that promoting investment can contribute to economic growth.*

Keywords*: Savings, Investment, Economic growth, ARDL, ECM, Granger causality*

Introduction

A nation can step into the pathway of development only if it has sufficient productive capacity which requires capital formation, which can be done either by utilizing domestic resources or through external assistance. The role of savings and investment in accelerating economic growth has garnered attention in growth theories and economic policies. Countries all over the world are making serious efforts to increase their productive capacity via savings and investments, especially after the global financial crisis in 2007. Literature advocates that savings play a key role for public and private investment in an economy. Researchers have observed that savings and investments are crucial macroeconomics factors not only for achieving the targeted growth levels, but it also ensures liquidity and price stability in the country.

In a typical model of economic growth (such as Solow, 1956), a clear connection is made between saving and economic growth. The conventional wisdom says: higher saving leads to higher investment which in turn leads to higher economic growth. The presumption is that higher saving precedes economic growth and higher saving causes economic growth. In this respect, attention has been given by the World Bank to propose that developing countries should take great care to raise their savings rate (rather than lower it) in order increase economic growth. The World bank in its multiple reports has stated that private investment is the amplifier for growth and uplifts the standard of living by reducing poverty. Hence, any policy which influences savings can also by default affect the investment and ultimately the growth of the country.

There are numerous theories which emphasize the role of savings and investment in maintaining and achieving economic growth. The growth theory given by Harrod-Domar is considered as one of the important theories which stress the involvement of savings and investment as key determinants of growth. Harrod equates demand and supply of saving while Domar forges a link between demand and supply of investment. From the theoretical point of view, there exist two schools of thought which is the Marx-Schumpeter-Keynes view versus Mill-Marshall-Solow view. In the Marx-Schumpeter-Keynes view, emphasis is placed on investment as the driving force behind economic growth, with savings playing a secondary role. The Mill-Marshall-Solow view, in contrast, emphasizes the importance of savings as the key driver of investment and capital formation, suggesting that higher savings rates will lead to greater investment and, in turn, sustained economic growth (Chakravarty, 1982 and Gutierrez & Solimano (2007).

In accordance with the Mill-Marshall-Solow approach, Jappelli and Pagano (1994) supported that savings contribute to higher investment which in turn contributes to higher GDP growth. The predicament of causality between savings, investment and economic growth has been in controversy since the beginning. Savings and investment are essential drivers in taking the economic growth process of a country forward. However, the importance of savings in developing countries depends on the long-debated economic theory which states that the rate of economic growth is the function of the rate of investment and the latter is constrained by the rate of domestic savings (Arndt, 1991). Accordingly, an emerging economy like India needs to be cautious when it comes to savings and investment to fulfill its growth targets and cater to the needs of the present and future generations.

India has strived to achieve a long run relationship with respect to gross domestic product from the initial days of Independence. The economy has attributed an increased role of savings and investment in the growth of the country in a sustainable form. Since independence, the major objective of India's economic policy has been the promotion of savings and capital formation as they are considered the key factors to fasten growth. Considering the aims of achieving sustainable growth in the long run of almost all the emerging economies, like India, the researchers feel it crucial to examine the long run cointegration between savings, investment and growth in Indian context.

Review of Literature

The relationship between economic growth and key macroeconomic variables is central to formulating effective macroeconomic policies. Early contributions by Harrod (1939) and Domar (1946), integrating Keynesian analysis with growth theory, emphasized the critical role of investment in driving economic growth. In contrast, the traditional economist (Lewis, 1955), emphasized the increased role of domestic savings to accelerate growth. On the similar frontier, Kaldor (1956), Samuelson and Modigliani (1966) examined the role of savings in strengthening the economy via increased growth. The neo-classical (Solow-Swan) model shifted focus to the role of savings, positioning

investment as a more passive force that adjusts to changes in the savings rate and contributes to long-term equilibrium.

Solow (1956) and Swan (1956) strongly believe that higher savings rate boosts the output. They stated that induced rise in income increases savings which further pushes the investment. McKinnon (1973) and Shaw (1973) reinforced the idea that savings are important in a country's economic development because they contribute to increased investment which accelerates economic growth. Tang and Chua (2012) and Patra et al. (2017) also supported the precedence of savings. On the contrary, the Carroll-Weil hypothesis (1994), Sinha and Sinha (1998), Salz (1998) suggest that it is economic growth that fosters higher savings, rather than savings being the primary driver of growth. This perspective aligns with the new growth theories of the 1990s, notably those of Romer (1986 and 1990), Lucas (1988), and Barro (1990), which emphasize that the accumulation of physical and human capital is the primary driver of sustained economic growth.

The stability of the financial system is crucial and imperative for the growth of a country (Kou et al. 2019). In the economic literature, the relationship between savings, investment and economic growth has been profoundly studied, but the outcomes remain mixed. Although there are many studies in the Indian context examining the relationship between savings and economic growth, their results are inconclusive. Some of them ignored the role of intermediate variables (the investment) in examining the relationship between savings and economic growth. To cite, Sinha (1996), observed no causality running in either direction while investigating the causal relation between gross domestic saving and economic growth; Sahoo et al. (2001) examined the long-run relationship between savings and growth and drew the inference that savings do not contribute to growth in India. Verma (2007), and Sinha and Sinha (2008) in their study concluded that saving does not cause economic growth, but economic growth causes savings. Singh (2010), and Mishra et al. (2010) found bidirectional causality between saving and economic growth. Patra et. al (2017) also examined the causal relationship between savings and economic growth and found no causality between savings and economic growth in the short-run; but a unidirectional causality running from savings to economic growth in the long-run. Saggar (2003) studied the role of investment rate in regard to real GDP growth in India. He observed that investment does granger cause GDP. Sandilands and Chandra (2003) mentioned that investment does not cause growth in the long run. Seshaiah and Vuyyuri (2005), in a study examining the nexus between savings and investment confirmed that there exists unidirectional causality running from savings to investment.Ribaj and Mexhuani (2021) in their study investigated the role of correlation between savings and economic growth in Kosovo and found that deposits have a significant positive impact on Kosovo's economic growth. Their analysis, supported by unit root tests confirming data stationarity, revealed that increased savings enhance investment, production, and employment, thereby promoting long-term sustainable economic development. For the BRICS nations, Chakraborty (2023) examined the causal relationship between domestic savings and economic growth using a panel ARDL model to analyze both short- and long-term dynamics. The study's findings reveal that gross domestic savings significantly contribute to economic growth in both the short and long run. Additionally, the results from bidirectional causality tests confirm a mutual causal relationship between savings and economic growth among the BRICS countries. Colak (2025) confirms a long-run relationship between savings, investment, and economic growth in Eastern Europe (1995–2021), with CS-ARDL results showing both savings and investment as key growth drivers. Causality tests further reveal a one-way causal link from savings and investment to economic growth.

Some researchers, Jangili (2011) used Johansen Juselius method of cointegration to examine the

relationship between savings, investment and growth. Based on findings of study indicating a long-run equilibrium relationship between three variables, the researcher reported that an increase in savings and investment will ultimately increase economic growth. Van and Kapingura (2021) investigates the relationship between savings and economic growth in South Africa from 1986 to 2018, using the Johansen cointegration technique and the Vector Error Correction Model. The results indicate a negative long-run effect of savings on economic growth, while a positive relationship is observed in the short run. Granger causality tests reveal a unidirectional causality from economic growth to gross domestic savings. Additionally, the study highlights the positive impact of investment on economic growth, underscoring the importance of promoting investment to achieve sustainable economic development. Joshi et al. (2019), studies the interplay between savings, investment, and economic growth in Nepal. The research identifies a long-term cointegration among these variables. Findings indicate that while investment positively influences economic growth, gross domestic savings have a negative long-term impact, highlighting inefficiencies in channeling savings into productive investments. Saxena and Fouzdar (2020) in a study on the relationship between savings, investment and economic growth in India observed the existence of a long-run relationship between the variables.

In nutshell, some studies show evidence of investment leading to growth and others find no clear relationship at all. However, most of the studies suggest that savings drive economic growth of nations. In view of the paucity of literature on intricacies of savings, investment, and economic growth, it is imperative to understand the dynamic interaction between savings, investment and economic growth which may help policymakers in formulating effective macroeconomic policies and strategies.

Objective of the Study

This article attempts to examine the dynamic interactions between savings, investment, and economic growth in an integrated manner in the Indian context during a period spanning from 1991-92 to 2022-23.

Research Method

This study used a quantitative research approach, which aims on analyzing data that can be measured in numbers. To analyze data, the study employed two methods: descriptive and inferential analysis. The descriptive method was used to gather detailed information about the current situation being studied. By collecting this data, the researcher aims to provide an accurate snapshot of the current state, and, where possible, provide conclusions based on the discovered facts. The inferential method focused on using statistical techniques to go beyond simple description and test whether the observed patterns were meaningful.

The present study is based on secondary data on variables under consideration spanning from 1991-92 to 2022-23. The data is sourced from the Handbook of Indian Economy, Reserve Bank of India. The variables include Real Gross Domestic Product (RGDP) as a proxy for real income, Gross Domestic Savings (GDS) calculated as the difference between Gross Domestic Product and final consumption expenditure, and Gross Fixed Capital Formation (GFCF) as a proxy for investment.

The study proceeds with the stationarity test of all the variables (GDP, GDS and GFCF) conducted through Augmented Dickey Fuller unit root test. It is imperative to know the order of integration to proceed further for the autoregressive distributed lag (ARDL) cointegration procedure introduced by Pesaran and Shin (1999) and Pesaran and Shin (1997). ARDL bounds cointegration approach is used to determine the cointegration between the variables. To find association between the variables in the long and short-run, ARDL and regression error correction terms (ECM) are used. Econometrics theory states that ARDL and ECM more rigorously examine the dynamic interactions between the variables in the long and short run. The model diagnostic

(serial correlation and heteroskedasticity) is examined by Breusch–Godfrey Serial Correlation LM Test and Breusch–Pagan-Godfrey test. The performance and stability of the model is examined through the CUSUM test. To check direction of causality among selected variables, a Granger causality test is used.

Model Specification

To assess the dynamic interaction between savings, investment and economic growth, the autoregressive distributed lag (ARDL) approach is used, as it has specific advantages over the alternative cointegration techniques (Pesaran and Shin, 1999). A key benefit of ARDL is that it does not require all variables to have the same order of integration, making it applicable to variables that are purely I(0), purely I(1), or even fractionally integrated but not 1(2). To examine the causation between the savings, investment and economic growth, the study postulates the following three specifications (suggested by Buddha, 2012).

$$GDP = \int (GDS, GFCF) \ldots\ldots\ldots\ldots (1)$$

$$GDS = \int (GDP, GFCF) \ldots\ldots\ldots\ldots (2)$$

$$GFCF = \int (GDP, GDS) \ldots\ldots\ldots\ldots (3)$$

Here, GDP = Gross domestic product, GDS = Gross domestic savings, and GFCF = Gross fixed capital formation.

Model – 1 represents that increase in savings (GDS) and investment (GFCF) contributes to output (GDP),

Model – 2 reflects the idea that a rise in investment (GFCF) and output (GDP) encourage savings (GDS),

Model – 3 treats GFCF as a function of GDP and GDS.

Although these factors are influenced by other factors, including income distribution, consumption, macroeconomic (monetary, fiscal and physical) policies etc., they are not captured in the basic model.

Analysis and Results

The order of integration is determined through Augmented Dickey-Fuller (ADF) unit root test. The results presented in table 1 indicate I(1) order of integration for all the three variables.

Table 1: Results of ADF unit root test

Variable	Level (I(0))		First difference (I(1))	
	Intercept	Intercept and trend	Intercept	Intercept and trend
RGDP	2.778 (1.0000)	-1.068 (0.9185)	-4.373 (0.0017) *	-5.703 (0.0003) *
RGDS	1.408 (0.9986)	-1.878 (0.6413)	-4.694 (0.0007) *	-5.115 (0.0014) *
RGFCF	2.000 (0.9998)	-1.591 (0.7731)	-5.210 (0.0002) *	-5.904 (0.0002) *

Notes: *(1) * Denotes the statistical significance at 1 percent. (2) The numbers within the parentheses for the ADF statistics are the p-values.*

Source: *Own calculations*

The ARDL model introduced by Pesaran, Shin, and Smith (2001) is suitable for testing cointegration when the variables are 1(0) or 1(1). When variables are integrated at I(0), the model can directly estimate short and long-run relationships, and if they are integrated at I(1), the ARDL approach can test for cointegration (long-run equilibrium relationship) through the Bound test. The Bound test uses F-statistics to test for cointegration. If the F-statistics is greater than the upper bound critical value, the null hypothesis of "no cointegration" is rejected, indicating that the variables are cointegrated. Since all variables considered in the study are integrated at I(1), further analysis to examine whether the variables are cointegrated or not is done by using bounds testing approach. The results are presented in table 2.

Table 2: Results of Bound cointegration test

Variables	Order of lag (AIC)	F-statistics
GDP	2	14.95
GDS	2	8.93
GFCF	2	11.38

Note: *(1) Statistical significance at 1 percent. (2) Critical values for upper and lower bound are (6.36, -5.15), (5.52, -4.41), (4.85, -3.79%), and (4.14, -3.17) at 1%, 2.5%, 5%, and 10% respectively.*

Source: *Own calculations*

The results show that the computed F-statistics for the Bound test, when alternatively, GDP, GDS and GFCF are taken as dependent variable exceeds both the lower and upper bound critical values at all significance levels, which allows us to reject the null hypothesis of no cointegration at 1%, 2.5%, 5%, and 10% significance levels. It provides robust evidence of cointegration between GDP, GDS and GFCF in the model. Therefore, we accept the alternative hypothesis of cointegration, signifying the variables long-run relationship and validating the feasibility of estimating a long-run ARDL model, also known as an Error Correction Model (ECM).

The long-run coefficients for real gross domestic product (GDP), gross domestic savings (GDS), and gross fixed capital formation (GFCF) presented in table 3. According to results, GDS and GFCF have a positive long-term impact on GDP, thus aligning with the crux of economic theory. When GDS is taken as a dependent variable, GDP is positively related to GDS in the long-run (coefficient = 0.4325), meaning that increase in GDP leads to an increase in GDS over time. GFCF has a negative relationship with GDS in the long-run, but this relationship is marginally significant (p-value = 0.098).

Table 3: Estimated long-run coefficients

Dependent Variables	Explanatory Variables		
	GDP	GDS	GFCF
GDP	-	1.799* (8.006)	0.975* (4.793)
GDS	0.432* (6.416)	-	-0.290 (-1.716)
GFCF	0.502* (4.099)	-0.543 (-1.752)	-

Notes: (1) ***** *Statistical significance at 1 percent.* (2) *Figures in parenthesis indicate t-values.*

Source: *Own calculations*

Results suggest that higher investment might reduce GDS in the long run, though the effect is not very strong. With GFCF being the dependent variable, the coefficient for GDP in the long run is positive and significant, implying that higher levels of GDP lead to higher GFCF. The coefficient for GDS is marginally negative, indicating that an increase in GDS might reduce GFCF in the long run, though this relationship is not statistically strong at the 5% level.

The results Error Correction Model (ECM) regression, presented in table 4, validate the short run relationship between the three variables considered in the study. The empirical results of GDP (dependent variable) indicate no short-run impact of GDS and GFCF on GDP. The coefficient for the error correction term for GDP indicates that about 86% of the disequilibrium from the previous period is corrected in the current period. The negative sign shows that the model is correcting towards the long-run equilibrium i.e., the dependent variable GDP returns to equilibrium over time.

Table 4: Results of ECM Regression

Variables	GDP	GDS	GFCF
DGDP	-	0.472*	0.627*
Coint. Eq. (-1)	-0.86*	-0.805*	-0.962*

Note: ** Significant at the 1%.*

Source: *Own calculations*

When GDS is the dependent variable, change in GDP in relation to GDS is significant and positive, indicating that a one-unit increase in GDP leads to a 0.472 increase in GDS in the short run. The coefficient of error correction term (0.805) implies that deviation from the long-run GDS path is corrected by 80.5% over the following year when shock arises. In the case of GFCF as a dependent variable, GDP is highly significant and positively related to GFCF. This implies that a one unit increase in GDP leads to a 0.6175 increase in GFCF in the short run. The error correction term (-0.962) is highly significant; it indicates that the model is well-adjusted to the long-run equilibrium relationship. Negative sign suggests that the system will correct deviations from the long-run equilibrium at a rate of 96.26% per period, meaning that any short-run disequilibrium will be corrected very quickly.

To check validity and reliability of the model Breusch-Godfrey Serial Correlation LM test, Breusch-Pagan-Godfrey heteroskedasticity test, and Ramsey RESET test are used. The test results are presented in table 5.

Table 5: Results of model diagnosis tests

Variables	F-Statistics		
	GDP	GDS	GFCF
Breusch-Godfrey Serial Correlation LM Test	0.902 (0.419)	1.22 (0.312)	0.998 (0.383)
Breusch-Pagan-Godfrey Heteroskedasticity Test	0.374 (0.772)	0.166 (0.953)	0.861 (0.500)
Ramsey RESET Test	0.002 (0.962)	1.283 (0.268)	0.549 (0.465)

Notes: *Figures in parenthesis are the probabilities of F-statistics.*

Source: *Own calculations*

The results of the Breusch-Godfrey serial correlation LM test indicate that the p-value for all the three variables is more than 0.05 at 5% level of significance. Thus, we accept the null hypothesis of absence of serial correlation in the model. The p-value associated with Breusch-Pagan-Godfrey heteroskedasticity test ($p > 0.05$) allows us to accept the null hypothesis of homoscedasticity, which asserts the absence of heteroskedasticity (a desirable outcome) in residuals of GDP, GDS and GFCF. The results of the Ramsey RESET test also show that the p-value for GDP, GDS, and GFCF is more than 0.05, allowing us to accept the null hypotheses. It validates that the models are well-specified, with no significant indication of omitted variables or functional form errors.

The results of Granger causality test indicate a bidirectional causality between GFCF and GDP, meaning that GFCF affects GDP and also gets affected by GDP (table 6). It supports Harrod and Domar theory which states that investment plays a key role in economic growth. No causal relation is observed between GDS and GDP, and GDS and GFCF.

Table 6: Granger Causality test

Null Hypothesis	F-Stat.	Prob.	Conclusion
GDS does not Granger Cause GDP	0.460	0.636	Do not reject
GDP does not Granger Cause GDS	0.099	0.905	Do not reject
GFCF does not Granger Cause GDP	4.738	0.018	Reject
GDP does not Granger Cause GFCF	4.306	0.025	Reject
GFCF does not Granger Cause GDS	1.757	0.194	Do not reject
GDS does not Granger Cause GFCF	1.040	0.368	Do not reject

Source: *Own calculations*

The stability of the model examined through cumulative sum of recursive residuals (CUSUM) tests indicate that the calculated statistics are falling within critical bounds corresponding to 5% significance level consistently (Figure 1 – 3). It indicates that the model is correctly specified, with no evidence of structural instability.

Fig. 1: Cumulative Sum of Recursive Residuals (GDP)

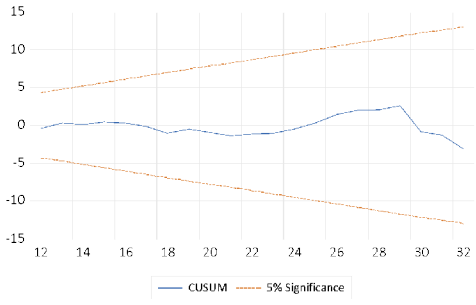


Fig. 2: Cumulative Sum of Recursive Residuals (GDS)

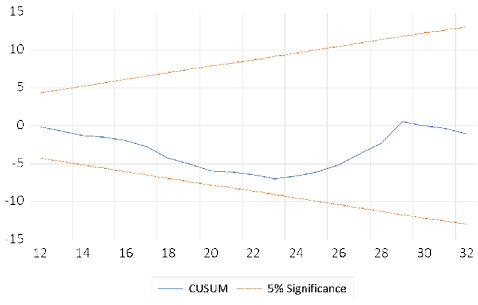
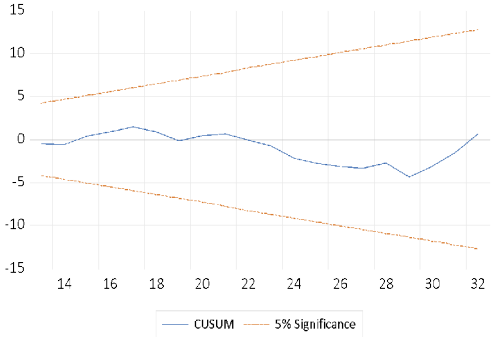


Fig. 3: Cumulative Sum of Recursive Residuals (GFCF)



Conclusion and Implications

This paper investigates the interdependence between savings, investment, and economic growth (GDP) in India during a period from 1991-92 to 2022-23 using annual time series data. It estimates both the long-run cointegrating relationships and short-run dynamics by applying the ARDL approach to cointegration. It also examines the direction of causality between GDS, GFCF and GDP through Granger causality tests. ARDL cointegration test provides robust evidence of cointegration between GDP, GDS and GFCF when alternatively, each of the variables is taken as a dependent variable. The long run coefficients for GDS and GFCF show a positive and long-term impact on GDP (dependent variable), thus aligning with the economic theory. In the case of savings being the dependent variable, there is a significant and positive impact of GDP on GDS, which suggests that increase in GDP will lead to an increase in GDS over time. But the long-run relationship between GFCF and GDS is found to be negative. In the case of GFCF as a dependent variable, the results provide strong evidence of the impact of GDP on GFCF in the long-run. The coefficient of GDS was found to be negative.

The short run relationship between the variables has been captured by the differenced variables which concluded that there is no short-run impact of GDS and GFCF on GDP. The error correction term for GDP projected that with the speed of 86%, GDP will bounce back to long-run equilibrium after a shock. When GDS is the dependent variable, GDP has a significant impact, indicating that a one-unit increase in GDP leads to a 0.472 increase in GDS in the short-run. The deviation in the GDS path is corrected by 80% over the following years when struck by an unprecedented crisis. In the case of GFCF as a dependent variable, GDP is significant and positive which confirms that in the short run, a unit increase in GDP will increase GFCF by 0.617 units. The error correction term GFCF model is highly significant indicating that the model is well adjusted to the long-run equilibrium relationship. The Granger Causality test confirms the bidirectional causality between GDP and GFCF, this is in accordance with the Marx-Schumpeter-Keynes view which places emphasis on investment as the driving force behind economic growth.

The policy implication which can be adopted from the study is that increasing the level of savings will eventually add up capital and ensure a sustainable and proper flow of funds that can support and cater to the growing investment needs in India. The rapidly changing economic environment demands the efficient allocation of funds towards productivity and profitability of India's own investment environment. The study provides evidence of long run cointegration between savings, investment and economic growth, therefore it is pertinent to frame policies which will drive savings such as income and wealth and make a path for the developmental activities and growth for the country rather than diverting the funds for the purpose of investment in other countries.

Future research directions

1. Future studies could delve deeper into the dynamics of savings, investment, and economic growth by identifying and accounting for structural breaks within panel data that can enhance the accuracy and reliability of econometric models, leading to more robust conclusions.

2. Future research could identify gaps in savings, investment, and economic growth by segmenting the study timeline into periods before and after major financial crises. This approach would allow for a clearer understanding of how such crises impact the relationships between these variables and could reveal shifts in economic behavior or policy effectiveness across different timeframes.

3. Conducting analyses at the sub-national level, such as examining various states or regions, can identify localized disparities in savings and investment patterns. Identifying states facing significant economic challenges enables the formulation of targeted policy measures thereby promoting balanced and inclusive economic growth across different areas.

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