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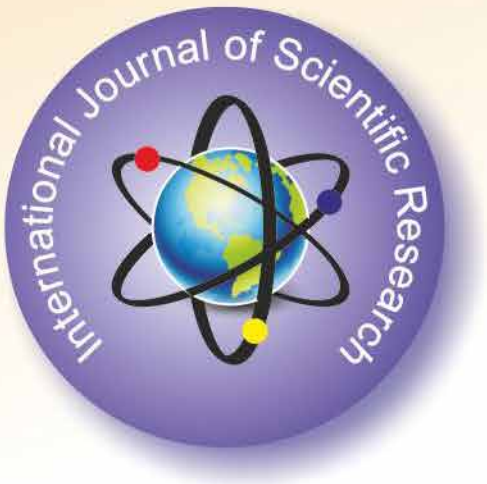

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Research Paper

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Growth - Saving Causality in India: A Cointegration Analysis

Economics

KEYWORDS : Growth, Saving, Causality, Cointegration, Granger

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ABSTRACT

The objective of this research paper is to empirically examine the growth-saving causal relationship in India for the planned economic era. The paper attempts to investigate the issue: whether growth causes saving or saving leads to growth in the country? The study has examined the long-run causal relationship between saving and national income at levels using the cointegration approach to Granger causality test. Empirical results indicate that in the long-run, the causal relationship is uni-directional from national income to gross domestic saving whereas the short-run causality is bi-directional between saving and income.

Introduction

There is a close relationship between the saving rate of the economy and the growth rate. The connection between saving and income can be viewed in two different ways. One point of view is that economic growth increases the propensity to save which leads to increase in aggregate savings. In the other view, saving seems to be causing growth. Savings give rise to capital formation or investment, which is the engine of economic growth. Thus, growth and saving are interdependent.

Although there is a close nexus between savings, capital accumulation and growth; the close association between saving and growth does not establish a long-run relationship of causation between the two. The causal relationship refers to the direction of relationship between saving and growth: Is it growth that causes saving or saving that causes growth? To arrive at these answers, this research paper attempts to study the growth-saving causal relationship in India.

The paper is spread over three sections. In the first section, the study covers a comprehensive review of literature on the issue of causality between saving and economic growth. The second section presents the methodology used to examine the growth-saving causality in India and the empirical results. This is followed by conclusion and observations in section three.

1. The Review of Literature

A survey of causality studies focussing on the relationship between saving and growth brings out a substantial divergence of outcomes. The 'capital fundamentalist' view identifies the strong connection between saving and growth variables as a causal chain running from saving to growth. This notion gets support from studies by Lewis (1955), Levine and Renelt (1992), Andersson (1999) and Kreickhaus (2002).

In contrast, there are studies that oppose the capital fundamentalist view. These are Modigliani and Brumberg (1954), Carroll and Weil (1994), Muhleisen (1997), Ray and Bose (1997), and Attanasio et al (2000). The empirical evidence from these literatures suggests that economic growth is the driving force behind saving. High growth leads to high saving, and not the other way around.

Joseph (1997) supports a two-way causal relationship between saving rate and growth rate in India. Still, in the quest of finding what comes first, whether saving or growth, a number of empirical studies like Sethi (1999), Sinha (1999, 2000), Anoruo and Ahmad (2001), Mishra (2006) and Mohan (2006) have failed to reach a clear consensus. In some cases, growth seems to be causing saving; or saving to be causing growth; for others either there is mutual causation between growth and saving or no link at all. Therefore, the debate on causality between economic growth and saving remains unresolved. The issue of causal chains is much more complex. The direction of causality between saving and growth may change because of differences in the methodology used; the choice of variable specifications and their definitions; from country to country and from period to period.

2. Methodology and Empirical Results

The objective of the study is to empirically test for the growth-saving causality in India. The problem is one of identifying the causal relationship between growth and saving. Whether it is economic growth that causes saving or is it saving which leads to growth? The following algebraic relationships need to be tested for causality.

S = ƒ [Y]
Y =ƒ [S]

There are several possible cases of causation which may be stated as:

i. Y causes S but S does not cause Y,
   Þ Uni-directional causation from Y to S [Y S]
ii. S causes Y but Y does not cause S,
   Þ Uni-directional causation from S to Y [S Y]
iii. Y causes S and S causes Y,
   Þ Bi-directional causation between Y and S [Y S]
iv. Y does not cause S and S does not cause Y,
   Þ Y and S are independent
   Or, no causal relationship between Y and S [Y∼∼ S]

2.1 Estimation Technique

The present study employs the Granger causality test using the cointegration approach for testing causation between saving and growth in India. As the study uses long time series data, the Granger causality test is relevant only when the variables involved are either stationary or non-stationary and cointegrated.

2.2 Specification of Variables

The present study has carried out the unit root test for (1) Saving at Levels [S] and (2) Growth Rate of Saving [DS/S], where Saving [S] has been defined as Gross Domestic Saving [GDS] at current prices. The Income measures taken are (1) Income at Levels [Y] and (2) Growth Rate of Income or Economic Growth Rate [DY/Y], where Income [Y] has been defined as Nominal National Income [Gross Domestic Product at current market prices].

2.3 Time Period and Data Source

The analysis for the present study on saving-growth causality in India covers a long period of the planning era from 1950-51 to 2003-04. The analysis is conducted using annual data of the relevant variables. The data have been compiled from issues of the Handbook of Statistics on Indian Economy [RBI].

2.4 Empirical Results

To examine the causality between saving and economic growth in India, Granger causality test has been performed using the cointegration approach. Suffice to mention here that the a priori requirement for cointegration test is that both dependent and independent variables should be stationary at the same level. Hence, all the variables are subject to unit root test to find out the level of stationarity. Thereafter, the variables are paired [based on the level of stationarity] for estimating cointegrating regression.

In the next step, after finding out the residual series from the cointegrating regression, the existence or absence of the long-run relationship between the saving and income variables have

been examined using the Augmented Engle-Granger [AEG] test. And finally, the selected pair of saving and income variables is tested for direction of causality using Granger causality test.

The empirical results have been presented in the following order:

2.4.1. Unit Root Test
2.4.2. Cointegrating Regression
2.4.3. Cointegration Test
2.4.4. Error Correction Model
2.4.5. Granger Causality Test - VEC Models

2.4.1. Unit Root Test

The results of the Augmented Dickey-Fuller [ADF] test for unit root have been given in Table 1.

Table: 1 Unit Root Test

Augmented Dickey-Fuller Test with a Drift Term
Lag = 1
Time Period : 1950-51 to 2003-04

Variables	ADF Test Statistic#			Order of Integration
	Level	First Difference	Second Difference	
Saving				
S	6.24	0.89	-6.36*	I [2]
ΔS/S	-7.44*	-	-	I[0]
Income				
Y	3.38	2.19	-3.68*	I [2]
ΔY/Y	-4.06*	-	-	I[0]
	Mackinnon Critical Values : 1% = -3.565 5% = -2.920 10% = -2.598			

Significance is based on Mackinnon critical values for rejection of hypothesis of a unit root.

* = Significant at 1%, ** = Significant at 5%, *** = Significant at 10%

The following inferences are made from the unit root test results. As the saving [S] and income [Y] variables are integrated of the same order [I(2)], they can be used for estimating the following cointegrating regression: S = ƒ [Y]. However, the growth rate of saving [ΔS/S] and growth rate of income [ΔY/Y] are integrated of the order zero [I(0)] and are therefore stationary at levels. As both of these variables are stationary and do not contain unit roots, the two cannot be subject to cointegration test. Causality between these two variables may be tested using standard causality tests. Hence, for further analysis we proceed only with the S - Y pair for estimating cointegrating regression.

2.4.2. Cointegrating Regression

The long-run equation is estimated by regressing Saving [S] upon Income [Y]. The cointegrating regression thus derived:

S = -8159.633 + 0.251 Y
[2.79] [73.70]*

R2	0.99	`R2	0.99	D-W 0.72

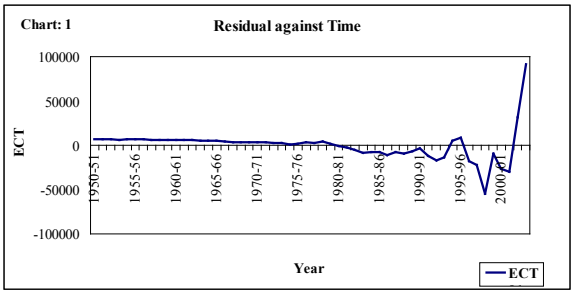
* t-values are significant at 1% level

The cointegrating regression is mainly estimated to derive the residual series for the actual test of cointegration. The coefficient value of the explanatory variable shows a long-run marginal propensity to save [MPS] equal to 0.251.

2.4.3. Cointegration Test

Cointegration test requires the residual series obtained from the cointegrating regression to be tested for unit roots. If the residual series is stationary or integrated of an order lower than I[2], then the two I[2] time series, in this case S and Y are cointegrated or share a long-run relationship. But prior to this, the residual series obtained from the cointegrating regression [denoted by ECT] has been plotted against time for observing whether it is stationary or not. If the residual series does not exhibit a continuous rising or falling trend, it is said to be stationary. Nevertheless, this is only a preliminary exercise and an additional test for confirming stationarity of the residual.

A linear combination of St and Yt yields the residual series ECTt stated as: ECTt=St–β1–β2 Yt. In Chart 1, we find that the behaviour of the residual series [ECT] obtained from the cointegrating regression between S and Y is stationary since it does not exhibit any continuous rising or falling trend.



The Augmented Engle-Granger [AEG] test is the actual test of cointegration between S and Y. It is similar to the ADF test stated earlier and is used to detect the presence of unit roots in the residual series. The AEG test result is presented in Table 2.

Table: 2
Test for Cointegration

Time Period : 1950-51 to 2003-04

Eqn. No.	Variables		AEG Test#				Inference
			ADF Test Statistic for Residual$				
	Dependent	Independent	Residual	Level	Order of Integration	Cointegration	
1.	S	Y	ECT	-2.49**	I[0]	Yes	Cointegrated : implies Granger causality
			Mackinnon Critical values: 1% = -2.607 5% = -1.947 10% = -1.619				

ADF test equation for unit root test of residual is without a constant and trend. It carries a lag of one-period for the dependent residual variable.

$ Significance is based on Mackinnon critical values for rejection of hypothesis of a unit root.

* = Significant at 1%, ** = Significant at 5%, *** = Significant at 10%

The result of the AEG test confirms the absence of unit roots in the series of residual obtained from the cointegrating regression. The residual series ECT is integrated of the order zero [I(0)] which is less than the order of integration of saving and income variables that is [I(2)]. Therefore, S and Y are cointegrated. The test confirms a stable long-run relationship between saving and income. This obviously implies the existence of Granger causality between S and Y.

2.4.4. Error Correction Model

After establishing the long-run relationship between saving and income variables, the Error Correction Model [ECM] is estimated to understand the short-run dynamics of saving-income relationship. The ECM is estimated for stationary saving and income variables [Δ2S and Δ2Y], including a lagged Error Correction Term [ECT] obtained from the cointegrating regression. The model is presented as:

Δ2S = - 613.576 + 0.295 Δ2Y - 0.801 ECT
[0.265] [2.72]* [4.54]*

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R2	0.33	`R2	0.31	D-W 2.41*

* Significant at 1% level

The following observations can be made from the Error Correction Model [ECM]:

i. The ECM for saving and income is not spurious. The D-W values are higher than the R2 values. D-W value for the model is significant at 1% level of significance, indicating that there is no problem of either positive or negative first-order autocorrelation in the residual.

ii. The model sports poor R2 and`R2 values but significant t-value of the explanatory variable. The short-run marginal propensity to save with respect to national income is almost same as the long-run marginal propensity to save at nearly 0.3.

iii. The coefficient of ECT or the speed of adjustment parameter is significantly negative, which reconfirms cointegration between saving and income variables, thereby providing an additional support for cointegration or the existence of a long-run equilibrium relationship between saving and income.

2.4.5. Granger Causality Test - VEC Model

Granger causality results provide evidence on the direction of causality between saving and income. Granger tests based on Vector Error Correction Models [VECM] also explain the existence or absence of short-run and long-run causality between variables, and the direction of causal link between them, whether uni-directional or bi-directional. Tables 3a and 3b present the VECM for the pair of gross domestic saving and national income [S and Y] that reveals the causality direction. The interpretation of these tables involves the following:

i. If the coefficients of the independent variables are jointly significant [as a group], or coefficient of at least one independent variable is significantly away from zero, it explains the short-run causality from the independent to the dependent variable.

ii. If the coefficient of the error correction term [ECT] is significantly away from zero, it indicates long-run causality from the independent to the dependent variable.

If the above two conditions are satisfied, it can be deduced that the independent variable Granger causes the dependent variable uni-directionally both in the short-run and long-run. The same principle is applied for examining the causal influence in the opposite direction. The final conclusion on uni-directional or bi-directional causality between the variables is made on the basis of the results obtained from the above two cases.

Table: 3a Granger Causality Test [Y to S]

Dependent Variable: Δ2S

Method: Ordinary Least Squares

Time Period : 1950-2003

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4590.730	1790.805	2.564	0.014
Δ2S-1	-0.445	0.182	-2.438	0.019
Δ2S-2	-0.278	0.194	-1.430	0.160
Δ2S-3	-0.436	0.159	-2.747	0.009
Δ2Y-1	0.382	0.113	3.393	0.002
Δ2Y-2	-0.505	0.148	-3.401	0.002
Δ2Y-3	-0.396	0.183	-2.165	0.036
ECT 01-1	-0.501	0.150	-3.335	0.002
R-squared :	0.739	F-statistic :		16.613
Adjusted R-squared :	0.695	Prob[F-statistic] :		0.000
D-W statistic :	1.419			

Inference:

The explanatory variables Δ2Y are jointly significant in explaining Δ2S. This explains the short-run causality from Y to S. Also, the coefficient of error correction term is significantly away from zero which indicates long-run causality from Y to S. Therefore, Y Granger causes S uni-directionally both in short-run and long-run.

Table: 3b Granger Causality Test [S to Y]

Dependent Variable: Δ^2Y

Method: Ordinary Least Squares

Time Period : 1950-2003

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5921.358	2888.737	2.050	0.047
Δ^2Y_{-1}	-0.167	0.182	-0.921	0.363
Δ^2Y_{-2}	-0.394	0.239	-1.645	0.108
Δ^2Y_{-3}	0.609	0.295	2.061	0.046
Δ^2S_{-1}	0.594	0.294	2.020	0.050
Δ^2S_{-2}	-0.207	0.314	-0.661	0.512
Δ^2S_{-3}	-0.803	0.256	-3.138	0.003
ECT 01_{-1}	0.180	0.243	0.741	0.463
R-squared :	0.429	F-statistic :		4.393
Adjusted R-squared :	0.331	Prob[F-statistic] :		0.001
Durbin-Watson stat :	1.464			

Inference:

The joint significance of the explanatory variables Δ2S confirms short-run causality from S to Y. However, there is lack of long-run causality from S to Y since the adjustment parameter for the error correction term is not significantly away from zero. Therefore, S Granger causes Y uni-directionally in short-run but not in long-run.

Final Conclusion and Summary - VEC Model

Causality Test Results		
Variables	Short-run Causality	Long-run Causality
S - Y	S Y	Y S

Granger causality test results for the VEC Model indicate that short-run causality is bi-directional between saving and income at levels while long-run causality is uni-directional from income to saving in the Indian case.

3. Conclusion and Observation

The saving rate of the economy and the growth rate share a close relationship. Theoretically, both saving and growth influence each other. Economic growth leads to higher savings and at the same time saving seems to be fuelling growth. In order to explore the nature and direction of causal relationship between Gross Domestic Saving [S] and Nominal National Income [Y], the study adopted the cointegration approach to Granger causality test. On the basis of the empirical results, the study concludes the following:

i. The gross domestic saving and national income share a uni-directional causal relationship from income to saving in the long-run, meaning thereby that higher national income leads to higher gross domestic saving in India. The marginal propensity to save being 0.3.

ii. In the short-run, gross domestic saving and national income share a bi-directional causal relationship, meaning thereby that higher saving causes higher income and higher income also leads to higher saving.

Thus, in the Indian case savings are definitely encouraged by higher economic growth. However, the marginal propensity to save both in the short-run and long-run is quite low. Keeping in view the short-run bi-directional causal chain between saving and income, it is equally important to enhance the savings in India for achieving higher economic growth and to augment

savings further, there is a need to focus on framing of saving incentive policies by the government.

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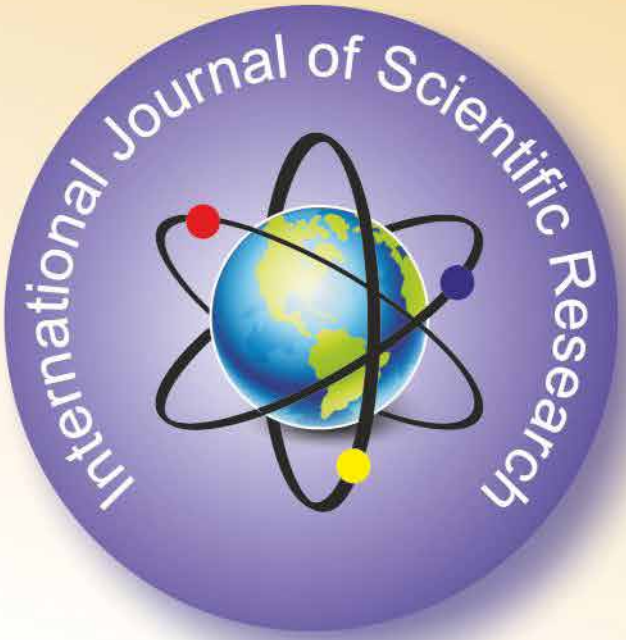

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