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**SAVINGS AND ECONOMIC  
GROWTH IN INDIA:  
THE LONG - RUN NEXUS**

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# SAVINGS AND ECONOMIC GROWTH IN INDIA: THE LONG-RUN NEXUS

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## Abstract

*In this paper, the causal nexus between savings and economic growth in India is investigated within the framework of causality, co-integration and error correction in the presence of a structural break, using annual data from 1950-1951 to 1998-1999. Identifying the structural breaks in both savings and economic growth in different time period, this study finds support for the long-run equilibrium between savings and economic growth. Further, the study reveals that there is a unidirectional causality from economic growth to savings, thereby repudiating the classical view that savings has been the engine of economic growth.*

## 1. Introduction

Savings, as a prerequisite to economic development, has been recognised in literature. A higher savings rate has been considered to be a major determinant of economic growth and development. The relationship between savings and growth is not only direct, but may also be looked at indirectly through investment. Higher savings lead to higher investment, which in turn will increase real output and employment if there are idle resources of labour, land and capital which can be absorbed in the economy (Lewis, 1970). According to the neoclassical paradigm, sustained growth of output is possible only when there is an increase in the propensity to save and invest. More specifically, it has been stated that output per worker will grow if the rate of savings exceeds the level that is required for both capital replacement and to

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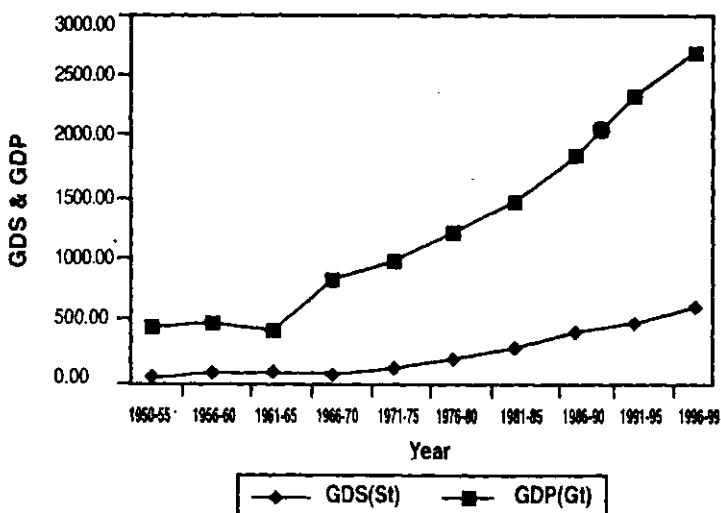
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equip any increase in the workforce. Rostow (1960) in his stage theory of economic growth has stipulated a savings rate of 16% as a basic pre-requisite to reach the take-off stage. Though the stage theory has no universal validity, there has been ample evidence during the period 1965-1989 that high rates of domestic savings have been accompanied by high growth rates.

In India, there has been a significant increase in savings over the years. But there is little evidence to show that increased savings have resulted in consistent growth. In the 1970s India's savings rate was high by developing country's standards, but the growth in savings did not bring about a proportionate increase in growth rate. On the contrary, in more recent times, economic growth has accentuated without any appreciable change in the savings rate, refuting that increase in savings and economic growth go hand in hand (see the graph). In this context, it may be of interest to examine the link between savings and growth in India. Accordingly, the objective of the study has been set to investigate the long-run nexus between savings and economic growth using the recent time series techniques.

**Graph: Plot of Savings and GDP: 1950-51 to 1998-99**



The studies examining the relationship between savings and growth have been largely descriptive in nature, and confined to correlating savings with economic growth. A few recent studies, however, have dealt with relating savings and growth within the framework of causality and cointegration. However, these techniques are developed to situations where there are no trend breaks in the variables. Therefore, an appropriate way of looking at the relationship between savings and growth would be to accommodate for the trend breaks in the analysis. Given the policy changes initiated under the new economic policy in India in the 1990s, where there has not been a synchronization of growth of savings and income, the issue assumes relevance in the analysis. The present study, therefore, attempts to reexamine savings and economic growth long-run linkage within the framework of cointegration and error correction mechanism by employing modified unit root tests which accommodate trend breaks (Perron, 1989; 1997).

Section II presents a brief review of literature on the subject, section III describes the data and the methodology employed, section IV presents the empirical analysis and results and section V reports the concluding remarks.

## **II. Review of Previous Work**

There are only a few studies that have examined the long-run relationship between savings and economic growth for different countries using cointegration and error correction mechanism. It may not be out of place to review some of them here, to provide a background and justification to the present study.

Schmidt et al. (1996) provide a policy-oriented review of recent theoretical and empirical work on the determinants of savings and investment, and their link to growth. They conclude that recent literature supports the view that savings and growth reinforce each other and that the causality runs in both the directions. The study states that to ensure an adequate level of savings remains a central policy concern, not only to guarantee sufficient financing for capital accumulation, but also to avoid an excess of investment over savings which may create inflationary pressures in the economy. He suggests that higher savings match the required level of capital accumulation for stable economic growth. The study, being confined to an overview of the studies, highlights the policy implications of the savings-growth nexus.

Muhleisea (1997) discusses the recent trends in Indian savings behaviour and reviews policy options to increase domestic savings. The study shows that private savings (household and private corporate savings) may not be enough to finance the government's growth target of 7 per cent over the

next decade. In his view a boost to domestic savings can be achieved by increasing public savings and by strong structural reforms including financial liberalization, which would initiate a virtuous growth-saving circle. Though he emphasizes the role of savings in economic growth, he fails to explain the long-run relationship between savings and economic growth in India.

Trying to trace the reasons for the high growth of savings in Chile, Morande (1998) shows how higher savings leads to higher economic growth. This paper empirically assesses the factors behind such a high rate of savings (around 26 % of GDP) by applying cointegration and error correction models. He identifies three factors responsible for high rate of savings viz., sustainability of growth, inflow of foreign savings and long-run capital market development, where he indirectly emphasises the stable and consistent economic growth for higher savings. The study, however, does not spell out clearly the causal relationship between savings and growth. Cardenas and Andres (1998) also analyse the determinants of savings in the Columbian context (1925-1994) and find that savings and investment are perfectly correlated, and savings Granger cause growth.

Sinha (1999) examines the relationship between savings and economic growth in Sri Lanka over the period 1950 to 1994. He distinguishes between two types of savings. One is gross domestic savings and another is gross domestic private savings. He explores the long-run relationship between gross domestic savings and GDP, as well as between gross domestic private savings and GDP, using the Johansen-Juselius cointegration framework. The results indicate that there is a long-run relationship between gross domestic savings and gross domestic private savings and GDP. Further, the evidence indicates that causality flows from both gross domestic savings and gross domestic private savings to economic growth. This implies that any increase in savings will positively lead to economic growth in the case of Sri Lanka.

Emphasizing that savings is an important determinant of economic growth, Sethi (1999) examines the causal behaviour between income and savings (at aggregate and disaggregate levels) in India over the period 1950-51 to 1996-97. Gross domestic income is disaggregated into income from (1) primary sector, (2) secondary sector and (3) tertiary sector; gross domestic savings is disaggregated into (1) household sector, (2) private corporate sector and (3) public sector each at current prices. The causality behaviour between different components (pair-wise) of disaggregated income and savings is examined through auto-correlation methodology. The results are quite varied, but largely counter the hypothesis that income determines savings. In a few cases, causality is observed to have run from income to savings, for instance causality running from primary sector income to household sector savings. The findings broadly

reveal that incomes of primary sector, tertiary sector and the aggregate income induce an effect on savings, especially in household and private corporate sector savings. The study has stressed the need for promotion of household and private corporate sector savings which may lead to saving-induced growth.

Chaudhri and Wilson (2000) examine the long-run relationships among savings, investment, productivity and economic growth in Australia over two time periods, 1861-1900 and 1949-90. The interdependence among these variables is tested using Johansen-Juselius cointegration and Granger causality. They conclude that there is no long-run relationship among the variables during the period 1861-1900, but there are two cointegrating vectors among the variables in the period 1949-1990. The study also shows that there is feedback causality between GDP and investment and a unidirectional causality running from GDP to savings. This study has used Dickey-Fuller, Augmented Dickey-Fuller, and Phillip-Perron unit root tests for examining stationarity of the variables which have been criticised on the ground of power and size distortion (Maddala and Kim, 1998). These unit root tests also do not account for trend breaks in the variables which may have given misleading results (Perron, 1989).

As the foregoing review reveals there are no studies in India, for that matter elsewhere too, which have tried to establish the long-run relationship and causality pattern between savings and economic growth within cointegration and error correction framework but accommodating the trend breaks in the variables. This paper attempts to fill the gap using advance unit root tests, taking care of the issue of trend breaks.

### **III Methodology**

The Grangerian framework for testing the bivariate causal relationship between saving ( $S_t$ ) and economic growth ( $G_t$ ) is based on the assumption that the relevant pair of variables is stationary, i.e. integrated of order zero, denoted by  $I(0)$ . This implies that the first step in Grangerian framework is to confirm whether each of the series is stationary or not. In case the variables are found to be stationary, the test may be carried. On the contrary, if the variables are non-stationary of the same order  $I(1)$ , the next step is to ascertain whether they are cointegrated. In case they are not cointegrated, a practical solution is to carry out the granger test in log first differences of the variables. In the event of cointegration, the next step is to rely upon an error-correction mechanism (ECM) which is bound to exist for a cointegrated system. The error correction provides an additional source of causation between the variables (see Engle and Granger, 1987; 1988). The additional source of causation through the ECM rules out one of the possibilities of the Granger test that the

variables are not related at all. This avoids the spurious causal inferences [see Miller and Russek (1990)]. The methodology of the present study follows this logic.

There has been an explosion of unit root tests in the econometrics literature for testing the stationary properties of the time series data. The most frequently used unit root tests are the Dickey-Fuller, Augmented-Dickey Fuller and Phillips-Perron unit root tests. One of the problems associated with these tests is their inability to account for the structural break in the variables, as these tests implicitly assume that the deterministic trend is exactly specified (Maddala and Kim, 1998). Perron (1989) argues that if there is a break in the deterministic trend, then the unit root tests may lead to misleading results, i.e., the tests may reveal the existence of a unit root when there is not. To overcome these problems, alternative unit root tests, which account for the existence of structural or trend breaks in the time series, have been developed recently. In this study, we use two unit root tests for checking the simultaneous existence of the structural break and unit root, namely, (i) Perron's unit root test for an exogenous break (1989) and (ii) Perron's unit root test for an endogenous trend break (1997).

Since the present study deals with only two variables viz., gross domestic saving ( $S_t$ ) and gross domestic product ( $G_t$ ), a simple two-stage Engle-Granger (E-G) cointegration procedure is adopted for testing the long-run relationship between  $S_t$  and  $G_t$ . In Engle-Granger cointegration framework, if the unit root tests indicate that both the variables  $S_t$  and  $G_t$  are  $I(1)$ , then the system consisting of these two variables is said to be cointegrated, provided the two error series obtained from regressing one upon the other are  $I(0)$ . In other words, the OLS regression yields a 'super consistent' parameter estimator if the variables in question are integrated. Keeping in mind the problems of low power and size distortions (Schwert-1987) of conventionally used unit root tests, we have used URSB (Bhargava, 1986) and ERS [Elliott, Rothenberg and Stock (1996)] unit root test for testing unit root as the null.

If  $S_t$  and  $G_t$  are cointegrated, an ECM representation could have the following form:

$$\Delta S_t = a_0 + a_1 (\Delta S_{t-1} - \Delta G_{t-1}) + \mu_t \quad \dots\dots\dots(1)$$

$$\Delta G_t = b_0 + b_1 (\Delta S_{t-1} - \Delta G_{t-1}) + \varepsilon_t \quad \dots\dots\dots(2)$$



where  $\Delta$  is the difference operator;  $a_0$ ,  $a_1$ ,  $b_0$  and  $b_1$  are parameters;  $t$  stands for time; and  $\mu_t$  and  $\epsilon_t$  are white noise disturbance terms. According to the ECM methodology, the short run behavior of the system is affected by the deviation from the long run equilibrium. If  $\Delta S_t$  and  $\Delta G_t$  are stationary, the right hand side of equations (1) and (2) should also be stationary, i.e.,  $I(0)$ . In this sense, if  $\mu_t$  and  $\epsilon_t$  are stationary, i.e.,  $I(0)$ , the linear combination  $(\Delta S_t - \Delta G_t)$  is also stationary. A more general specification of the system of equations (1) and (2) can be expressed in the form:

$$\Delta S_t = a_0 + a_1 \delta_{t-1} + f(\Delta S_{t-1}, \Delta G_{t-1}) + \mu_t \quad \dots\dots\dots(3)$$

$$\Delta G_t = b_0 + b_1 \phi_{t-1} + g(\Delta S_{t-1}, \Delta G_{t-1}) + \epsilon_t \quad \dots\dots\dots(4)$$

where  $\delta_{t-1}$  and  $\phi_{t-1}$  are error correction terms. The error correction term  $\delta_{t-1}$  in equation (3) is the lagged value of the residuals from an OLS regression of  $S_t$  on  $G_t$  while  $\phi_{t-1}$  in equation (4) corresponds to the lagged value of the residuals from an OLS regression of  $G_t$  on  $S_t$ . In equations (3) and (4),  $\Delta S_t$  and  $\Delta G_t$  are stationary, implying that their right hand side must also be stationary. It is obvious that equation (3) and (4) constitute a bivariate VAR system in first differences augmented by the error correction terms  $\delta_{t-1}$  and  $\phi_{t-1}$ .

According to Granger (1987, 1988), in a cointegrated system of two series, expressed by an ECM representation, causality must run at least one way. Within the ECM formulation [equations (3) and (4)],  $S_t$  does not Granger cause  $G_t$  if all the coefficients associated with  $\Delta S_{t-1}$  in equation (4) should be zero and  $b_1 = 0$  and similarly,  $G_t$  does not Granger cause  $S_t$  if all the coefficients associated with  $\Delta G_{t-1}$  in equation (3) should zero and  $a_1 = 0$ .

#### IV. Empirical Analysis

In the present study both gross domestic savings ( $S_t$ ) and gross domestic product ( $G_t$ ) are expressed in real terms. Here, we exclude foreign savings as the objective of the study to analyse the long-run relationship between domestic savings and economic growth. The relevant data have been compiled from *Economic Survey* of the Government of India. The period of study is from

1950-51 to 1998-99. Here, we have taken the total savings instead of taking household, private corporate and public sector savings separately, as both private corporate sector and public sector savings constitute an insignificant portion in the total savings. Considering the policy changes and macro economic fluctuations experienced by the Indian economy over the last fifty years, a trend break in either or both of  $S_t$  and  $G_t$  is a strong possibility. Therefore, it is necessary to ascertain whether such a break exists. Using the knowledge about the exact break point, the stationary properties of  $S_t$  and  $G_t$  are investigated.

Accordingly, we have employed the Perron's (1989) exogenous unit root test (see section-I of appendix) and Perron's (1997) endogenous unit root test (see section-II of appendix). The test for structural break is conducted by testing the shift in trend of the time series. Table-1 reports the Perron's exogenous structural break test statistics for  $S_t$  and  $G_t$  in their levels and in first differences which assume that the date of possible change in the intercept or slope is fixed *a priori*. As evident from table-1, Perron's exogenous structural break unit root test statistics fail to reject the null hypothesis of a unit root for both the series in levels. The null hypothesis of non-stationarity is rejected at 5% and 10% level in first difference. This suggests that the variables are integrated of order one  $I(1)$  i.e. non-stationary. The break periods are 1992 and 1991 in the original series and first difference respectively.

We have also used the Perron's endogenous structural break test in which the break date is not assumed *a priori*. The results of the test are reported in table-2. Similar to Perron's exogenous structural break unit root test, all the three models of Perron's endogenous trend break test statistics fail to reject the null of a unit root for both  $S_t$  and  $G_t$  series in the levels. But the null is rejected in first differences in all the three models. This suggests that the variables are  $I(1)$ . Column 3 and 5 of table-2 show the trend breaks in each series but it is very difficult to find out the economic reasons for the respective trend breaks in different periods.

**Table-1**  
**Perron's Exogenous Structural Break Test**  
**1950-51 to 1998-99**

Variables	Break	Levels	Break	First differences
		t statistics		t statistics
$S_t$	1992	0.828(-3.68)	1991	-4.643(-3.68)*
$G_t$	1992	-2.136(-3.68)	1991	-3.807(-3.68)*

**Note :** Figures in parentheses refer to critical values at 5% significance level. This is Perron's model- 'b' for unit root test allowing both under null and alternative hypothesis for the presence of one time change in the level or in the slope of the trend function using the linear regression model which are constructed by nesting corresponding null and alternative hypothesis. Here we have chosen only model-b because the other two models are showing inconsistent result. Critical values are obtained from Perron (1989). The regression model is given in the appendix.

**Table-2**  
**Perron's Endogenous Structural Break test:**  
**1950-51 to 1998-99**

Variables	Models	Break	Levels	First differences	
			t statistics	Break	t statistics
$S_t$	io1	1966	-3.77(-5.23)	1987	-8.66(-5.92)*
	io2	1966	-4.31(-5.59)	1987	-8.59(-6.32)*
	ao	1973	-4.08(-4.83)	1987	-8.37(-5.45)*
$G_t$	io1	1963	-2.76(-5.23)	1987	-9.71(-5.92)*
	io2	1980	-4.08(-5.59)	1976	-5.31(-5.29)**
	ao	1958	-4.06(-4.83)	1977	-4.57(-4.48)**

**Note :** \* significant at 5% level \*\* significant at 10% level.

Figures in parentheses refer to critical values at 5% and 10% levels.

After testing that both  $S_t$  and  $G_t$  exhibit a structural break at different times in different tests and are stationary after differencing, we perform the Engle-Granger cointegration test to examine whether they possess the common trends. As required by the E-G cointegration procedure, the error series  $U_{1t}$  is obtained by regressing  $S_t$  on  $G_t$ . Similarly the error series  $U_{2t}$  is obtained by regressing  $G_t$  on  $S_t$ . Then the error series  $U_{1t}$  and  $U_{2t}$  is tested for the presence of a unit root. Table-3 reports the results estimated from URSB and ERS unit root tests. As it is clear from table-3, both the error series  $U_{1t}$  and  $U_{2t}$  do not have a unit root, or these series are trend stationary i.e.,  $I(0)$ . This evidence supports for cointegration of the two variables  $S_t$  and  $G_t$  in the long run.

**Table-3**  
**Engle-Granger Cointegration Procedure:**  
**Unit Root Tests for the Error Series  $U_{1t}$  and  $U_{2t}$**

Variables	URSB Test#		ERS Test	
	$R_1$	$R_2$	PT(0.5)	DFGLS
$U_{1t}$	1.576(0.26)**	0.872(0.35)**	3.727	-5.317(-2.58)*
$U_{2t}$	1.667(0.26)**	1.024(0.35)**	-3.356	-5.366(-2.53)*

**Note :** #  $R_1$  and  $R_2$  are two test statistics of the Sargan-Bhargava unit root test (1986).

\*Significant at 1% level. \*\* At 5% level.

Critical values for URSB are obtained from Sargan-Bhargava Unit root test (1986).

Critical values for ERS are obtained from Elliot et al (1996).

Having verified the variables that  $S_t$  and  $G_t$  are cointegrated, we next investigate the causal pattern between  $S_t$  and  $G_t$  within the ECM framework. Table-4 reports the parameter estimates obtained from ECM methodology. Three lags are used for the cointegrated system. The lag length is confined to 3 to conserve degrees of freedom. The error correction terms  $\delta_{t-1}$  and  $\phi_{t-1}$  reflect the long run dynamics and appear in the set of regressors. The significance level of the coefficients of  $\delta_{t-1}$  and  $\phi_{t-1}$  are expected to provide meaningful insights into the long run causal relationship between  $S_t$  and  $G_t$  and the immediate impact on the system of the variables  $\Delta S_t$  and  $\Delta G_t$ .

**Table-4**  
**Estimates of ECMs for  $\Delta S_t$  and  $\Delta G_t$  : 1950-51 to 1998-99**

Variables	$\Delta S_t$	$\Delta G_t$
Constant	-727.11 (-1.37)	-992.7 (-1.07)
$\Delta S_t$ (-1)	-0.26 (-2.31)	-0.43 (-2.13)**
$\Delta S_t$ (-2)	-0.52 (-5.0) *	-0.79 (-4.9)*
$\Delta S_t$ (-3)	-0.21 (-2.6) *	-1.008 (-7.9)
$\Delta G_t$ (-1)	0.24 (4.29) *	0.44 (4.47)*
$\Delta G_t$ (-2)	0.09 (1.53)	0.65 (5.95)*
$\Delta G_t$ (-3)	0.12 (2.65)*	0.26(3.39)*
$\delta_{t-1}$	0.41(3.09)*	-
$\phi_{t-1}$	-	-0.04(-1.109)
$R^2$	0.94	0.98

**Note :** \* Indicates significance at 1 % level.

\*\* Indicates significant at 5 % level.

Figures in the parentheses refer to critical values.

Table-4 clearly indicates that the variables  $\Delta S_t$  (-2),  $\Delta S_t$  (-3),  $\Delta G_t$  (-1) and  $\Delta G_t$  (-3) are statistically significant. Similarly, the regression of GDP on savings shows statistically significant results for  $\Delta S_t$  (-1),  $\Delta S_t$  (-2),

$\Delta G_t$  (-1),  $\Delta G_t$  (-2) and  $\Delta G_t$  (-3). However, the ECM results suggest that the GDP has powerful long and short run effects on the savings. The lagged error term  $\delta_{t-1}$  is significant in the regression equation of  $\Delta S_t$  revealing the strong positive impact of GDP on savings. Though the lagged savings are significant, the lagged error term (t-1) carries an insignificant t-statistics in the regression equation  $\Delta G_t$  indicating the weak evidence of savings on GDP. Overall, the ECM estimates indicate a one-way causality from  $\Delta G_t$  to  $\Delta S_t$  in the long-run as well as short-run. Thus, the classical maxim, " saving as the engine of growth " is refuted in the Indian context. The high adjusted  $R^2$  statistic indicates that the estimated ECM model fits the data adequately.

### Concluding Remarks

The focus of this paper is to examine the causal nexus between savings and economic growth in India, using the annual data from 1950-51 to 1998-99. The evidences from the error correction models show a unidirectional causality from GDP to savings supporting the view that economic growth influences savings in the Indian context. The results obtained in this paper refute the statement that savings serve as the engine of economic growth as postulated by the classical economics.

### Appendix Section-I

#### Perron's test for unit roots and exogenous structural breaks (1989)

The Perron (1989) technique performs a unit root test of a given series in the presence of an exogenously given trend break. It considers three models; where the first allows for an exogenous change in the level of the series; the second permits an exogenous change in the growth rate of the series and the third permits both. For a given series say,  $y_t$  these models may be specified as follows

$$\text{Model a: } Y_t = c + \theta \text{ DMU}_t + \alpha \text{ TREND} + \beta \text{ DTB}_t + U_t$$

$$\text{Model b: } Y_t = c + \theta \text{ DMU}_t + \alpha \text{ TREND} + \gamma \text{ DTS}_t + U_t$$

$$\text{Model c: } Y_t = c + \theta^* \text{ DMU}_t^* + \alpha \text{ TREND} + \delta \text{ DT}_t + \beta \text{ DTB}_t + U_t$$

Where  $c$  is a constant,  $\theta$ ,  $\theta^*$ ,  $\alpha$ ,  $\gamma$ ,  $\delta$ , and  $\beta$  are parameters,  $U_t$ 's are the error terms and  $\text{DTB}_t$ ,  $\text{DMU}_t$ ,  $\text{DTS}_t$ ,  $\text{DMU}_t^*$ ,  $\text{DT}_t$  are dummy variables which are defined as follows:

$DTB = 1$  if  $t = TB + 1$  (TB is time break), 0 otherwise.

$DMU_t = 1$  if  $t > TB$ , 0 otherwise.

$DTS_t = t - TB$  if  $t > TB$ , 0 otherwise.

$DT_t = t$  if  $t > TB$  and  $DMU_t^* = 1$  if  $t > TB$ , 0 otherwise.

Presence of a trend break in the series is confirmed by the test of significance of the dummy variables. As already mentioned, only model-b has been used as the other two models are giving inconsistent results.

## Section-II

### Perron's test for unit roots and endogenous structural breaks (1997)

In contrast with Perron (1989), the Perron (1997) technique conducts a unit root test of a given series when the break period is endogenously determined. It considers the following model and allows a change in both intercept and slope. The model is given by

$$Y_t = c + \alpha_t + \beta D(Tb)_t + \gamma DU_t + \theta DT_t + U_t$$

Where  $c$  is a constant,  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\theta$  are parameters,  $U_t$  is an error term,  $t$  is linear trend,  $Tb$  is endogenous time break, and  $DU_t$ ,  $D(Tb)_t$  and  $DT_t$  are the dummy variables which are defined as follows:

$$DU_t = 1 \text{ if } t > Tb, \quad DT_t = t \text{ if } t > Tb \\ D(Tb)_t = 1(t = Tb + 1)$$

Presence of trend break in the series is confirmed by the test of significance of the dummy variables.

## References

- Bhargava, A (1986), 'On the Theory of Testing for Unit Roots in Observed Time Series', *Review of Economic Studies*, pp.369-384.
- Cardenas, M and E Andres (1998), 'Savings Determinants in Columbia', *Journal of Development Economics*, Vol. 57, pp.544.
- Chaudhri, D P and E Wilson (2000), 'Savings, Investment, Productivity and Economic Growth of Australia 1861-1990: Some Explorations', *The Economic Record*, Vol.76, No. 232, pp.55-73.
- Elliot, G, T J Rothenberg, and J H Stock (1996), 'Efficient Tests for an Autoregressive Unit Root', *Econometrica*, Vol. 64, pp. 813-836.

- Engle, R F and C W J Granger (1987), 'Cointegration and Error Correction: Representation, Estimation and Testing', *Econometrica*, Vol. 55, pp. 251-276.
- Engle, R F and C W J Granger (1988), 'Some Recent Developments in a Concept of Causality', *Journal of Econometrics*, Vol. 39, pp.199-211.
- Lewis, A (1970), *Theory of Economic growth* (George Allen and Unwin Limited, London).
- Maddala, G S and In-Moo Kim (1998), *Unit Roots, Cointegration and Structural Change*, (Cambridge University Press, UK).
- Miller, S M and E S Russek (1990), 'Cointegration and Error Correction Models: The temporal causality between Government taxes and Spending', *Southern Economic Journal*, Vol. 56, pp. 221-29.
- Muhleisea, M (1997) 'Improving India's Saving Performance', *IMF Working Paper*, January, pp.24.
- Morande-Feleipe, G (1998), 'Savings in Chile-What Went Right?' *Journal of Development Economics*, Vol. 57, #.1, pp. 201-228
- Perron, P (1997), 'Further Evidence on Breaking Trend Functions in Macro-Economic Variables', *Journal of Econometrics*, Vol. 80.
- Perron, P (1989), 'The Great Crash, the Oil Price Shock and the Unit Root Hypothesis', *Econometrica*, Vol. 57, November, pp.1361-1401.
- Rostow, W W (1960), *The Process of Economic Growth*, (Oxford University press: Oxford)
- Sethi, A S (1999), 'Causal Behaviour between Income and Saving in India-Evidence from Cross-Correlation Approach', *Anvesak*, Vol.29, No.2, pp.119-123.
- Sinha, D (1999), 'Saving and Economic Growth in Srilanka', *Indian Journal of Applied Economics*, Vol.8, No.3, pp.163-174.
- Schmidt-Hebber, K, L Serven and A Solimano (1996), 'Saving and Investment: Paradigms, Puzzles, Policies', *The World Bank Research Observer*, Vol.11, No.1, pp. 87-117.
- Schwert, G W (1987), ' Effects of Model Specification on Tests for Unit Roots in Macroeconomic Data', *Journal of Monetary Economics*, Vol. 20, pp.70-103.





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