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Old Wine in New Bottles: Saving – Growth Nexus: Innovative Accounting Technique in Pakistan

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Abstract. *The paper re-investigates the relationship between economic growth and domestic savings by applying new approaches rather than old techniques. The cointegration and causality approaches have been applied for economic growth and domestic savings. In doing so, ARDL Bounds Testing, Johanson cointegration approaches are employed to examine for long run association while Innovative Accounting Techniques and Toda and Yamamoto (1995) for causal relationship has been applied. Ng-Perron de-trended test is used for order of integration of running actors. Results reveal that there exists a long run relationship between economic growth and domestic savings and their association is robust at least in long span of time. Causal results through innovative accounting technique assert that there is one-way causality running from economic growth to domestic savings while very weak from opposite side. Results by Toda and Yamamoto's technique also confirm that economic growth leads domestic savings in Pakistan.*

Keywords: economic growth; savings; causality; ARDL.

JEL Codes: O0, E22, C32.
REL Code: 8E.

1. Introduction

According to Lewis's (1955) conventional development theory "savings stimulate the economic growth through investment activities" while saving behavior also encourages the economic growth (Kaldor, 1956, Samuelson, Modigliani, 1966). In 1990s, contrary to conventional theory, a new aspect emerged, i.e. "savings contribute to accelerate investment which enhances Gross Domestic Product (GDP) in short span of time" (Bacha, 1990, DeGregorio, 1992, Jappelli, Pagano, 1994). A number of studies showed that economic growth encourages the savings (see, for instance, Sinha, Sinha, 1996, Sinha, Sinha, 1998, Salz, 1999, Anoruo, Ahmad, 2001, Ramesh, 2006, Sinha, Sinha, 2007). Edwards (1995) has argued that economic growth is one of the most important determinants of not only private savings but also for public savings(1).

In economic literature researchers have utilized different econometric techniques and probed the issue but are inconclusive. For example, Bacha (1990), Otani and Villanueva (1990), DeGregorio (1992), and Jappelli and Pagano 1994) have employed Ordinary Least Squares (OLS) regression using cross-sectional data and concluded that higher savings leads to higher economic growth. Recently, Krieckhaus (2002) argues that high level of national savings lead to higher investment and hence contribute to higher economic growth. The concept of Granger-causation in this area appeared by Caroll and Weil (1994). They have concluded that economic growth causes high savings. Using five-year averages of the economic growth rate and savings for OECD countries, Attanasio et al. (2000) notes that using annual data rather than the five-year average increases exactness and significance of empirical estimation as well as direction of causal relation.

Sinha and Sinha (1996) conclude that economic growth leads to higher savings in the case of transition economy like Pakistan. Sinha and Sinha (1998) have aslo investigated the causal relationship between economic growth and savings for Mexico and found that it runs from economic growth to domestic savings(2). Furthermore, Sinha and Sinha (2007) have investigated the same relationship for Philippines and concluded that economic growth leads to higher domestic savings. On the other hand, causality is also found from gross domestic savings to economic growth for Sri-Lanka (Sinha, Sinha, 1999). Saltz (1999) investigates the causal relationship between the same variables by employing Vector Error Correction (VEC) and VAR (Vector Auto Regressive) model. The study concludes that higher growth rate of real GDP contributes to a higher growth of savings. Anoruo and Ahmad (2001) seem to employ VEC to find out direction of causality between domestic savings and economic growth in seven African countries. They posit that there is bi-directional causality for Cote d'Ivoire and South Africa. Only for Congo, growth rate of domestic savings lead economic growth.

Mavrotas and Kelly (2001) investigate direction of causal relationship among gross domestic product, gross domestic savings, and private savings through employing Toda and Yamamoto (1995) technique for India and Sri Lanka. They conclude that for India no causality between GDP growth and private savings exists while for Sri-Lanka bi-directional causality prevails. Agrawal (2001) examines the causality between GDP and saving for a number of Asian countries and concluded that for most of countries causality flows from GDP to saving. The study is also conducted to find the direction of causality for Singapore, South Korea, Malaysia, Thailand, and the Philippines by Baharumshah et al. (2003). The study has employed VECM on time series data from 1960-1997 and found that there is no causality between gross domestic savings and economic growth except for Singapore. Ramesh (2006) determines the direction of same type of causality for high income countries, lower middle countries, upper middle countries and lower income countries and supports the hypothesis that economic growth leads to higher gross domestic savings. The relationship between saving and growth differes for economies due to their economic structure and, possibly, due to different data spans and econometric techniques. To entangle the relationship of Pakistan, it is attempted by new techniques and fresh data.

The present study is an innovative addition in the literature due to its difference from existing literature. It is different from the previous ones in the following aspects: the long-run association and its robustness is examined through ARDL Bounds Testing and Johansen Cointegration techniques; for direction of causality Innovative Accounting Technique and Toda and Yamamoto (1995) is employed; and to check the order of integration of variables Ng-Perron (2001) is applied.

2. Methodology

Vector Auto Regression (VAR) approach is commonly used to investigate the dynamics of the relationship between two macroeconomic variables, also for the variables like gross domestic savings and economic growth. VAR is usually applied to avoid shortfalls of endogeneity and integrating order of variables**.** The present endeavor is different as it would employ Innovative Accounting Technique (Impulse Response Function and Variance Decomposition) to investigate causal relationship. It is based on the property that forecast error variance decomposition allows inferences to be concluded with reference to the proportion of movements in particular time periods due to its own shocks and shocks arising from other variables in the VAR. By using VAR, impact of a shock can be checked in a particular variable traced through the system of equations that determine the impact on other variable and also variables that includes future values of shocked variables[(3)].

This approach breaks down the variance of the forecast error for each variable following a shock to particular variable that makes possible to identify which variable affects strongly and vis-à-vis impact. For example, a shock in economic growth leads subsequently to a change in gross domestic savings in the estimated VAR approach, but shock in gross domestic savings has only minor or small effect on economic growth. From this exercise, we can infer and conclude that economic growth leads gross domestic savings or causality runs from economic growth to gross domestic savings.

On the other hand, impulse response function investigates the time path of the effects of shocks of independent variables. This approach also determines how each actor responds over time to the first shocks in other variables. So these two methods are named as Innovative Accounting that allows an intuitive insight into the dynamic relationship between gross domestic savings and economic growth. They are applied on the annual time series data starts from 1971-2007 for Pakistan.

According to variance decomposition, it breaks down the forecast error for gross domestic savings and economic growth, if gross domestic savings explain more of the variance. Under the discussion above a VAR system is established that makes following model:

$$V_t = \sum_{i=1}^{k} \delta_i \times V_{t-1} + \eta_t \qquad (1)$$

Where, $V_t = (LEG, LGDS)$, and $\eta_t = \langle \eta_{LEG}, \eta_{LGDS} \rangle$, $\delta_1 - \delta_k$ are two by two matrices of coefficients and η is a vector of error terms. LEG = log of economic growth proxied by income per capita and LGDS = log of gross domestic savings as share of GDP.

3. Results and discussion

Ng-Perron (2001) test is employed to investigate the order of integration for the said actors. The results of unit root test at level and at 1st difference with constant and trend are shown in Table 1. The values of *MZa, MZt, MSB & MPT* are greater than critical values indicating non-stationary at level. Results at the 1st difference show that both variables are stationary. It concludes that economic growth and gross domestic savings are having *I(1)* order of integration.

Table 1

Variable's order of integration*

Ng-Perron at level				
Variables	MZa	MZt	MSB	MPT
LEG	-9.1833	-2.0172	0.2196	10.3964
LGDS	-10.624	-2.2484	0.2116	8.84327
Ng-Perron at 1st difference				
LEG	-16.9357	-2.9052	0.1715	5.4087
LGDS	-31.4951	-3.8847	0.1233	3.3594

*Ng-Perron (2001, Table 1)

Table 2

ARDL estimation with parsimonious model results

ARDL with Constant & Trend			
Dependent Variable	F-Statistics	Wald- Statistics	Chi-square
LEG	*11. 284*	8.889 (0.0013)	17.778 (0.0001)
LGDS	5.798	3.349 (0.0522)	6.698 (0.0351)
Critical Bounds	Instability Level	*Lower Bound*	*Upper Bound*
Pesaran et al. (2001)	1%	8.74	9.63
	5%	6.56	7.30
	10%	5.59	6.26

Table 3

Johansen first information maximum likelihood test for co-integration

Hypotheses	Trace-Test	5 percent critical value	Prob-value**	Hypotheses	Max-Eigen Statistic	5 percent critical value	Prob-value
R = 0	35.4882	18.3977	0.0001	*R = 0*	33.5729	17.1476	0.0001
R ≤1	1.91531	3.8415	0.1664	*R= 1*	1.91531	3.8415	0.1664

**MacKinnon, et al. (1999) p-values.

After obtaining the order of integration of running actors, Tables 2 and 3 show evidences of the existence of long-run relationship between gross domestic savings and economic growth in Pakistan(4). ARDL bounds testing approach is intimating the one cointegrating vector between variables like Johansen First Information Maximum Likelihood test for cointegration.

Table 4 shows that how the forecast error variance of the variables can be broken down into components that can be attributed to each of our variables in VAR. It shows the exact explanations about their relationship through innovative shocks while forecast error variance decomposition of unrestricted VAR (3) models are estimated over a 10-year forecast time horizon.

From the test it may be concluded that each time series describes the prevalence of its own values. Economic growth explains more than 97 percent of its forecast error variances that is explained through its own innovative shocks. The gross domestic savings show innovative impact through its own shocks which is nearly 58 percent. It shows that economic growth is predominantly explained by its past values or innovative shocks and mildly through gross domestic savings. It is concluded that current economic growth influences future growth trends. Gross domestic savings lead economic growth not more than 3 percent through its innovative shocks while economic growth leads gross domestic savings by more than 42 percent through their innovative shocks on each. The phenomenon explains that there is one-way causality running from economic growth to gross domestic savings. It is supported by Sinha and Sinha's (1996) arguments for Pakistan based on simple Granger causality approach.

Table 4

Variance decomposition percentages of 35-year error variance

	Typical shocks in	
Percentage of forecast error variation in	LEG	LGDS
LEG	97.30	2.70
LGDS	42.11	57.89
Toda and Yamamoto for Granger causality		
variables	LGNPC	LGDS
LEG	-	0.058
LGDS	8.065*	-

To test the robustness of the causality between economic growth and domestic savings Toda and Yamamoto (1995) technique has also been employed(5). The results of Table 4 show that only economic growth leads the gross domestic savings but gross domestic savings has not causal relation with economic growth. The results are matching with the results by Innovative Accounting Techniques.

Finally, impulse response function is used to investigate the time paths of log of economic growth (LEG) in response to one-unit shock to log of gross domestic savings (LGDS) and vice versa. A graphical representation of impulse response function provides a spontaneous insight into dynamic relationships as it shows that how economic growth responds over time to a shock in gross domestic savings and vise versa.

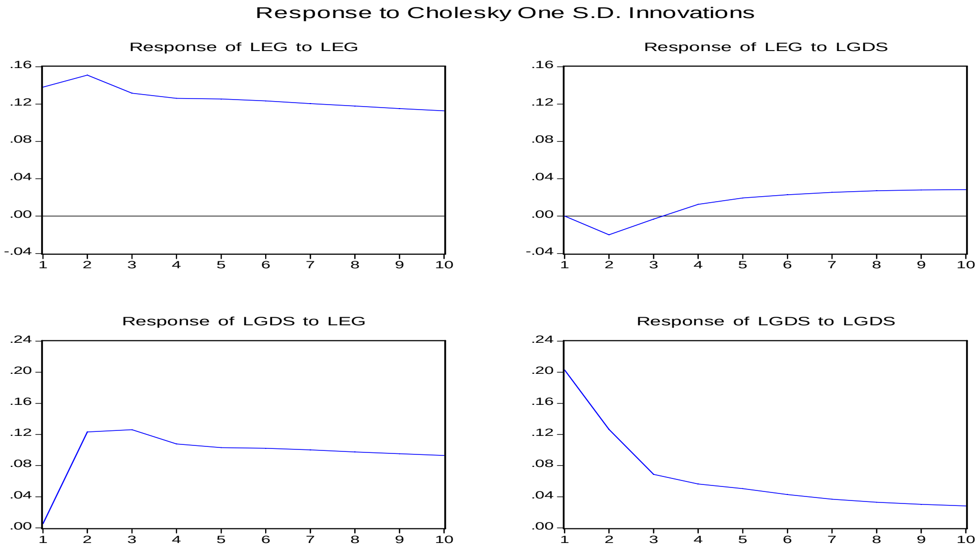

Figure 1. *Impulse response function*

4. Conclusion

The objective of the study is to reinvestigate the long-run relationship between economic growth and savings in Pakistan. For the purpose ARDL Bounds and Cointegration techniques were applied. The results explain that there exists long run relationship between economic growth and gross domestic savings. To find out the direction of causality, Innovative Accounting Approach and Granger-causality by Toda and Yamamoto (1995) are applied. Both results suggest that economic growth leads to the gross domestic savings that means the direction of causality is from economic growth to domestic savings but there is no response from opposite side. This shows that Pakistan is a consumption pattern country and less focuses to save money for investment projects both at macro and micro level.

Notes

[(1)] Caroll et al. (2000) demonstrated that "if utility depends partly on how consumption compares to a *habit stock* determined by past consumption, an otherwise-standard growth model can imply that increase in growth can cause increased saving."

[(2)] Triantis (1997) questioned the validity of the life cycle model.

[(3)] The methodology of Innovative Accounting technique is based on Shahbaz.

[(4)] Methodological Framework of both ARDL and Johansen Co-integration approaches is given in Appendix-A.

[(5)] One of the shortcomings of the Granger causality test procedure is that the variables used in the test must be stationary. While the main advantage of Toda and Yamamoto (1995) is that it allows for the variables in the VAR to be non-stationary or even co-integrated. It therefore allows us to test for causality between the levels of economic growth with domestic savings even though if both actors are known to be non-stationary.

[(6)] The second advantage of using the bounds testing approach to Co-integration is that it performs better than Engle and Granger (1987), Johansen (1988) and Philips and Hansen (1990) Co-integration test in small samples (see e.g. Haug, 2002). The third advantage of this approach is that the model takes sufficient number of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson, Chai, 2003). However, Pesaran and Shin (1999) contented that, "appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous variables".

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Appendix-A

A1. ARDL bounds testing procedure

The ARDL approach to cointegration is selected as it performs better in small sample sizes than other cointegration techniques. Besides, it is applicable irrespective of whether the underlying regressors are purely $I(0)$, purely $I(1)$ or mutually cointegrated[(1)]. The statistic underlying this procedure is similar to Wald or F-statistic in a generalized Dickey-Fuller type regression, which is used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium error correction model (ECM) (Pesaran et al., 2001). The ARDL approach involves estimating the following unrestricted error correction model (UECM):

$$\Delta Y_t = a_\circ + \sum_{i=1}^{p} \alpha_1 \times \Delta Y_{t-i} + \sum_{i=1}^{p} \alpha_2 \times \Delta X_{t-i} + \beta_1 \times Y_{t-1} + \beta_2 \times X_{t-i} + \varepsilon_{1t} \quad \ldots . \qquad (2)$$

(1) The second advantage of using the bounds testing approach to Co-integration is that it performs better than Engle and Granger (1987), Johansen (1988) and Philips and Hansen (1990) Co-integration test in small samples (see e.g. Haug, 2002). The third advantage of this approach is that the model takes sufficient number of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson, Chai, 2003). However, Pesaran and Shin (1999) contented that, “appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous variables”.

Where Δ is the difference operator, p represents the lag structure, Y_t and X_t are the underlying variables, and ε_{1t} and ε_{2t} are serially independent random errors with mean zero and finite covariance matrix. The null hypothesis is H_0: $\beta_1 = \beta_2 = 0$, i.e. there exists no long-run equilibrium relationship, and the alternative hypothesis is $H_1: \beta_1 \neq \beta_2 \neq 0$ (Pesaran et al., 2001). These hypotheses are tested using the F-test. However, this test has non-standard distributions depending on the sample size, the inclusion of intercept and trend variable in the equation, and the number of regressors. The estimated ARDL test statistics are compared to two asymptotic critical values reported in Pesaran et al. (2001, pp. 300-304) rather than to conventional critical values. If the test statistic is above an upper critical value, the null hypothesis of no long-run relationship can be rejected regardless of the orders of integration of the underlying variables. The opposite is the case if the test statistic falls below a lower critical value. If the sample test statistic falls between these two bounds, the result is inconclusive.

A2. Johansen Co-integration

In order to test the robustness of the results, we also applied the traditional Johansen cointegration procedure. The Johansen (1991, 1995) Cointegration involves investigation of the p-dimensional vector Autoregressive procedure of k^{th} order:

$$\Delta X_t = \alpha + \sum_{i=1}^{k-1} \Gamma_i \times \Delta \times X_{t-i} + \Pi \times X_{t-k} + \eta_t \quad (3)$$

where Δ is the first difference lag operator, X_t is a $(p \times 1)$ random vector of time series actors with order of integration equal to *I(1)*, α is a $(p \times 1)$ vector of constant, Γ_i are $(p \times p)$ matrices of parameters, η_t is a sequence of zero-mean p-dimensional white noise vectors, Π is a $(p \times p)$ matrix of parameters, the rank of which contains information about long-run link between the underlying variables. Vector error-correction model (VECM) expressed in equation reduces to an orthodox vector autoregressive (VAR) model in first differences if the rank *(r)* of Π is zero, while if Π has full rank $p=r$, all elements in X_t are stationary. Further more, $0 < r < p$ suggests the prevalence of r cointegrating vectors, such that there exists $(p \times r)$ matrices, δ and β each of the rank *r* such that $\Pi = \delta \times \beta^{'}$, where the columns of the matrix, δ is adjustment factors and rows of the matrix β is the cointegrating vectors with property that $\beta^{'} \times X_t$ is stationary even though X_t may comprise of individually *I(1)* process. Test of the hypotheses that the number of Cointegration vectors is at most r (r = 1, …2, p) are conducted utilizing the likelihood ration (trace) test for reduced rank in the context of restrictions forced by Cointegration on the unrestricted VAR involving series X_t.