Savings - Economic Growth Nexus in Bangladesh: Evidence from Causality, Cointegration and Error Correction Models

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Abstract

The dynamic causal relationship between gross national savings and gross domestic product remains a contentious and lively issue in the literature. Even though the literature on this issue is voluminous, however for Bangladesh it is quite nascent. The paper explores the dynamic causal relationship between gross national savings and gross domestic product in Bangladesh over a long period of time (1974-2010) by applying Granger causality test, Johansen and Juselius cointegration test and Engel and Granger error correction models considering the stochastic properties of the variables. The issue of the short run dynamics of savings and other variables within a long run relationship has also been examined in the paper. The estimated results show that both variables are nonstationary at their levels and stationary at first differences. Then using cointegration technique it has been found that both the considered variables are cointegrated, implying that there is a stable long run relationship between gross national savings and gross domestic product. The error correction model shows that the considered variables drift apart in the short run, however in the long run there is bidirectional causality between savings and economic growth. The implication of the result is that mobilising domestic savings are critical for capital accumulation and so for economic growth. The Granger causality test also shows the same result. Therefore attempts have to be made to increase national savings for capital accumulation and output growth in Bangladesh.

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1. Introduction

Economists have long been examining the causes and the process of economic growth. Despite that process of economic growth remains the most complicated and empirically contentious issues in the literature. Over time different schools of thought and economists like Frank Ramsey (1928), Allyn Young (1928), Frank Knight (1944), Joseph Schumpeter (1934) and Harrod (1939) & Domar (1946) analyzed growth process of the capitalist economies identifying different determinants of economic growth (Hossain, 2011a). Evidence shows that a stable savings-investment relationship is very crucial for sustained economic growth. This emanates from the fact that savings contribute to higher investment and hence higher GDP growth at least in the short run (Bacha, 1990; DeGregorio, 1992; Jappelli and Pagano, 1994).

The relationship between savings and investment and so economic growth has first been formally explained by Lewis (1955). The main idea of Lewis's (1955) traditional theory was that increasing savings would accelerate growth by accumulating capital in the developing countries. The idea of Lewis has been empirically tested by Domar-Harrod models. The H-D model specified investment as the key to promoting economic growth. On the other hand, in the 1950's and 1960's the neoclassical growth model of Solow-Swan variety became dominant in the thinking of the economists. Though these models are considered as exogenous, however argues that the increase in the savings rate boosts steady-state output by more than its direct impact on investment because the induced rise in income raises savings, leading to a further rise in investment (Hossain, 2011a).

Using the Solow-Swan model, authors like Jappelli and Pagano (1994), Alguacil et al. (2002) among others, reported that higher savings growth precedes higher economic growth. In fact, Olajide (2009) findings that a unidirectional causality runs from saving to economic growth suggest that the low level of saving may be responsible for the sluggish and unimpressive growth in Nigeria over time. In addition, the World Bank (1993) views that higher savings rates account the differences in economic growth between developed and developing economies. However, the proponents of the Keynesian hypothesis stressed that it is growth of output (or income) that causes growth of saving. The supporters of this theory argue that increases in investment leads to increase in income, thus raising the level of saving in the economy. For instance, the work of Carroll and Weil (1994) which suggested that economic growth preceded savings motivated further researches that aim at ascertaining the direction of causality between saving and economic growth. To this end, Gavin et al. (1997), Sinha and Sinha (1998), and Agarwal (2001) confirmed that higher economic growth precedes and causes higher savings.

The H-D and Solow and Swan type of long run growth model has come under challenge in the 1970s and in the early 1980s due to the fact of short-term fluctuations of economic growth as experienced by many countries. Economists then focused more on short run fluctuations than on long run economic growth. However, growth theories back in fashion in the mainstream economics in the late 1990s after the publications of Romer (1986) and Lucas (1988). These later growth theories are known as 'endogenous growth models' and are based on micro foundations to analyze macroeconomic issues. These models differ from the traditional growth models of Smith, Ricardo, Malthus and Marx and sheds light on the basic approaches of competitive behavior and equilibrium dynamics, the role of diminishing returns and its relation to the accumulation of physical and human capital, the interplay between per capita income and the growth rate of population, the role of technology and technological change in the growth process, discovery of new techniques and the monopoly power as an incentive for technological progress (Barro and Matin: 2004). The basic premises of these theories are also the direction of causation from savings to investment and economic growth. Empirical testing for savings and economic growth nexus in Bangladesh is thus imperative.

The major objective of this paper is to examine the long run relationship between gross domestic savings, and gross domestic product in Bangladesh i.e. to see whether they are cointegrated or not. It also sheds lights on the causal relationship between the considered variables using the time series data for the period 1974 to 2010. Data for gross domestic savings (GDS), and gross domestic product (GDP) were taken from the Bangladesh Bureau of Statistics (2012).

To examine the dynamic linkages among the variables the paper has taken into account of various modeling issues that arise in causality framework. The study considers the stationary properties of the data on output and investment by applying the Augmented Dicky Fuller (ADF) test. Then the Johansen and Juselius test has been applied to examine the cointegration i.e. the long run relationships among the variables. The Error Correction models and Granger causality test have been applied to examine the short run dynamics of long run relationships between savings and output.

The paper is articulated as follows. After introducing the issues in section 1, section 2 provides a brief review of the recent literature on the issue. Section 3 sheds light on the relationship among savings and economic growth trend in Bangladesh. Section 4 sets out the framework for testing stationarity, cointegration, error correction models and causality between the variables and also reports and interprets the results. Finally, section 5 concludes the paper with policy implications.

2. Brief Review of the Literature

The role of savings on economic growth has widely been discussed in both theoretical and empirical literatures. According to Keynes an increase in investment has additive effect on aggregate demand, which led to decrease in unintended inventory and consequently increase in output level (Froyen: 2002), while the classical economists explained the economic growth into the class division between the worker (labor) and capitalist class. According to the classical economists' labor as a class gets subsistence wage and consume all of their proceeds and thus do not contribute to economic growth. Capitalist, on the other hand contribute to the economic growth by investing part of their profit to the directly productive activities and on discovering new technologies for reaping more benefit. Hence in the classical model capitalists' savings and so the investment positively affects technology, which led to the upward shift of the aggregate production function and so the level of output (Foley and Michl, 1999).

Harrod (1939) and Domar (1946) models of growth, which are biased to Keynesian analysis in examining economic growth conclude that the new investments representing net addition to the capital stock is the engine of economic growth. However, empirical evidence for Harrod and Domar was not strong enough, thus led to the emergence of Solow (1956) and Swan (1956) model. These models are known as exogenous growth model and are based on new classical production function of Cobb Douglas variety and assume diminishing returns to each input and constant returns to all inputs together. However, the empirical evidence found that growth of the output is exogenously determined and most part of growth can be explained by Solow residuals. The implication is that the accumulation of capital stock has only the level affect on output, thus is not denying explicitly the role of investment (Hossain, 2011a:415).

Following Solow, authors such as McKinnon (1973) and Shaw (1973) supported the view that saving plays a crucial role in economic development. This is true because rising saving increases the level of investment, thereby accelerating economic growth (Sinha and Sinha, 1998). In the life-cycle hypothesis, Modigliani (1970) suggested that higher growth raises the life-time wealth of young (working) savers relative to retired (non-working) dissavers, thus raising the total savings of the economy. The increase in national savings in turn leads to higher investment and expansion of output.

Economists mislay their interests on the traditional growth theories of Harrod and Domar and Solow and Swan due to the lack of wide empirical evidence and in the backdrop of short run fluctuations of output due to mainly the oil shocks in many developing and developed countries. Bacha (1990) and Jappelli and Pagano (1994) claimed that savings contribute to higher investment and higher GDP growth in the short-run. However, the Carroll-Weil hypothesis (Carroll-Weil, 1994) states that it is economic growth that contributes to savings, not savings to growth. Thus, establishing the unidirectional causality from output growth to savings.

In the late 1980s long run growth theories back in fashion in the mainstream economic analysis after the publications of Romer (1986) and Lucas (1988). Their work has further been extended by Arrow (1962), Sheshinski (1967) and Uzawa (1965). These models ignored the diminishing returns to capital (which was the central assumption of the neoclassical exogenous growth models) by using a broad class of capital goods using the concept of human capital along with the tangible capital goods and concluded that individual investors invests a portion of their capital besides directly productive activities to research and development which thought to constitute social overhead capital and thus have positive impact on output. Thus the above discussion provides an indication that investment that resulted from the accumulation of capital (from savings) has causal impact on output growth. However, reverse causality has also been well documented (Chakravarty, 1993 and Solimano, 1997).

Sinha (1996) presented evidence that economic growth Granger causes growth of savings in Pakistan. Further, Sinha and Sinha (1998) found that causality was from the economic growth to growth of savings in Mexico. Sinha (1999) examined the relationship between the increase of savings and economic growth in Sri Lanka. In this study, the causality was from gross domestic savings to economic growth. However, Sinha (2000) did similar studies in the Philippines and found causality from economic growth to domestic savings.

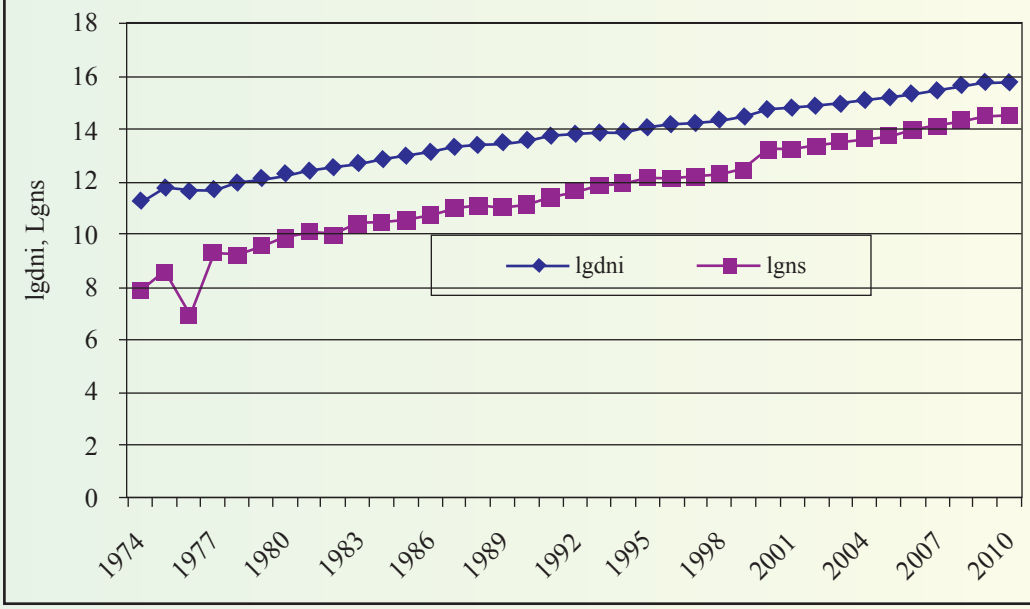
Olajide (2009) employed the Toda and Yamamoto (1995) and Dolado and Lutkepohl (1996) methodology to investigate the direction of causal relationship between saving and economic growth in Nigeria during the 1970 to 2006 period. The causality test results the existence of a unidirectional causality between savings and economic growth and the complementary role of FDI in growth.

Though the empirical literature on savings and economic growth are ample, for Bangladesh it is quite nascent that applied time series econometric techniques. An early study by Chowdhury (2001) examined the impact of financial liberalization on private savings in Bangladesh. A recent study by Agrawal and Sahoo (2009) emphasized on the determinants of savings and examined the impact of financial development (measured through the number of bank branches and financial policies, such as the interest rates on bank deposits and broad money) on the savings rate. This paper focuses mainly on the trends of saving and economic growth in Bangladesh as well as the direction of causality of the savings-growth relation.

3. Savings-Economic Growth Nexus in Bangladesh[1]

Bangladesh, a resource scarce country is burdened by over mass of population. However, is motivated to achieve economic growth since its independence in 1971. In a war-damaged economy, the domestic savings and so the accumulated capital was so low for investment in directly productive activities. The economy follows socialistic attitude in economic management and the government nationalizes all heavy industrial states. The rebuilding and using these states and so new addition to the capital stock was the sole responsibility of the state and the economy suffers from low economic growth. In the 1980s, being advised by the World Bank and IMF Bangladesh has adopted economic liberalization as a strategy to rapid economic growth. Private savings and investment in this period becomes substantial in the business and in the industrial sector. This results a sustained growth (though low) of output over a long period of time. The following figure gives some insights on the behavior of Bangladesh's gross national savings and gross national income over the period of 1974 to 2010.

Figure 1: Savings-Economic Growth Nexus Bangladesh



It is clear from the figure that although savings and output drift apart at times, they follow common stochastic trends implying that they are cointegrated. However, this needs to be addressed by using recent econometric development in the literature.

4. The Analytical Framework

4.1 Data

This study is based on the annual data for the period 1974 to 2010 taken from the various publications of the Bangladesh Bureau of Statistics (BBS). Data for gross national savings (GNS) and gross domestic product (GDP) as an indicator of economic growth were taken from the Bangladesh Bureau of Statistics (2012). Econometrics estimation has been done by using Eview-7.0.

4.2 Methodology and Results

The traditional practice in testing the direction of causality between two variables has been to use the standard Granger (1969) framework. In a two variables system the standard Granger causality test consists of estimating the following equations:

$$Y_t = \beta_0 + \sum_{i=1}^{m} \beta_i Y_{t-i} + \sum_{j=1}^{n} \alpha_j X_{t-j} + u_t \qquad (1)$$

$$X_t = \gamma_0 + \sum_{i=1}^{m} \gamma_i X_{t-i} + \sum_{j=1}^{n} \delta_j Y_{t-j} + v_t \qquad (2)$$

where u and v are mutually uncorrelated white noise error series and *t* denotes time period. Causality may be determined by estimating equations (1) and (2) and testing the null hypothesis that $\alpha_j = \delta_j = 0$ for all j's against the alternative hypothesis that $\alpha_j \neq \delta_j = 0$ and for at least some j's. If the coefficients's are statistically significant but δ_j 's are not, then Y is said to have been caused by X. The reverse causality holds if δ_j 's are statistically significant while α_j 's are not. If both α_j and β_j are significant, then causality runs both way.

The stationarity properties of the series are not taken into consideration in the standard Granger causality test which may report one-way, or two-way causality or no causality. However, if the variables are cointegrated, the modified Granger causality test rules out the possibility of no causality when the variables share a common trend. The estimation of the Granger causality test involves three steps. Step I includes the identification of the order of integration of the variables under consideration. Cointegration can be tested through the Engle-Granger two-step method (Engle and Granger, 1987) or by the Johansen and Juselius (1990) in step II. In this study we use the latter approach. In step III, we proceed with the standard Granger causality test by adding the residuals obtained from the cointegrating regressions (as error-correction terms) in estimating the modified Granger causality equations.

4.3 Testing for the Order of Integration

The first step consists of determining the order of integration of the variables under consideration. This is done by using the Augmented Dickey- Fuller (ADF) test (Dickey and Fuller, 1981) as follows:

$$\Delta Q_t = \phi_0 + \phi_1 t + \gamma_0 Q_{t-1} + \sum_{i=1}^{n} \psi_t \Delta Q_{t-1} + \varepsilon_t \qquad (3)$$

In the above equations, Q_t is a random walk with drift around a stochastic trend, Δ is the first difference operator, ε_t is the white noise error term. The null hypothesis that Q is a nonstationary time series is rejected if γ_0 is less than zero and statistically significant. The ADF test is carried out by replacing Q_t with GDP_t and GNS in equation (3) respectively.

The result is further justified by Phillips and Perron (1988) test. The results of these tests are presented in Table 1.

Table 1: Test for Integration

Variable	ADF		Phillips-Perron	
	Level	First Difference	Level	First Difference
lngdp	-1.185	-10.204*	-1.717	-10.280*
lngns	-1.209	-11.845**	-1.186	-17.217*

Note: * and ** denotes the rejection of the null hypothesis at the 1% level and 5% level respectively.

Source: Authors own formulations based on Eviews 7.0

Table 1 shows that the time series are non stationary i.e. *I(0)* at their levels, while first difference made them stationary. That is each of the series lngdp and lngns are integrated of order 1, *I(1)*.

4.4 Testing for Cointegration

The existence of a long-run relationship between economic variables is considered as cointegration (Thomas, 1993). In other words, a long-run relationship means that the variables move together over time so that any short-run deviations from the long-run trend will be corrected (Manning and Andrianacos, 1993). The main idea behind cointegration

is that if, in the long-run, two or more series move closely together, even though the series themselves are trended, the difference between them is constant. It is possible to regard these series as defining a long-run equilibrium relationship, as the difference between them is stationary (Hall and Henry, 1989). A lack of cointegration suggests that such variables have no long-run relationship and they can wander arbitrarily far away from each other (Dickey et. al., 1991).

Figure 1 shows that the series have a common movement that is they may be cointegrated. Empirically this calls for testing for the existence of linear independent and the so called cointegrating relationship:

$$\sum_{j=1}^{2} \chi_{jt} Y_{jt} = \nu_{it} \quad i = 1,\ldots\ldots,r \qquad (4)$$

The υ_{it} are *I(0)* series, although the Y_{jt} are *I(1)*. Under *I(0)* of υ_{it} the long run relationship of Y_{jt} (j= 1, ..2) is determined by 2-r common trends. This can be tested empirically either by Engle-Granger (1987) two step cointegration procedures or by Johansen-Juselius cointegration (1990) technique. We relied on Johansen-Juselius cointegration technique, which requires identifying the number of cointegrating vectors, namely the trace statistic and the maximum eigenvalue test statistic. The Trace test statistic for the null hypothesis that there are at most *r* distinct cointegrating vectors is

$$\lambda_{trace} = T \sum_{i=r+1}^{N} \ln(1 - \lambda_i) \qquad (5)$$

where, λ_i's are the N-*r* smallest squared canonical correlations between Y_{t-k} and ΔY_t (where $Y_t = (\text{In } gdp_t)$[1] and all the variables in Y_t are assumed *I(1)*), corrected for the effects of the lagged differences.

The maximum eigenvalue statistic for testing the null hypothesis of at most *r* cointegrating vectors against the alternative hypothesis of *r* + 1 cointegrating vectors is given by

$$\lambda_{\max} = -T \ln(1 - \lambda_{r+1}) \qquad (6)$$

Johansen (1988) and Johansen and Juselius (1990) shows that equations (2) and (3) have non-standard distributions under the null hypothesis and provides approximate critical values for the statistic, generated by Monte Carlo methods. Table 2 shows the results of the application of Johansen procedure.

Table 2: Unrestricted Cointegration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.430831	21.67765	15.49471	0.0051
At most 1	0.054257	1.952446	3.841466	0.1623

Note: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 3: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.430831	19.72520	14.26460	0.0062
At most 1	0.054257	1.952446	3.841466	0.1623

Note: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Authors own formulations based on Eviews 7.0

Table-2 and Table 3 shows the result of trace tests of Johansen and Juselius (1991) suggest that the considered time series are cointegrated. That is there is at least one cointegrated relationship at 1% level of significance implying that there is a stable long run relationship between gross national savings and gross domestic product in Bangladesh. That is additive savings have some important long run implications to changes in GDP in Bangladesh. However, we need to test what happens to their relationship in the short run, which is shown from the results of error correction models.

4.5 The Error Correction Models

Since the considered variables are cointegrated, the standard Granger causality test is modified by incorporating the error correction terms obtained from the cointegrating regressions as follows:

$$\Delta Y_t = \beta_0 + \rho_1 \eta_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \alpha_j \Delta X_{t-j} + u_t \qquad (7)$$

$$\Delta X_t = \gamma_0 + \rho_2 \mu_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta X_{t-i} + \sum_{j=1}^{n} \delta_j \Delta Y_{t-j} + v_t \qquad (8)$$

where all variables are stationary time series, is the first difference operator and and are the error correction terms which represents the lagged residuals from the cointegrating equations, *m* and *n* are the lag lengths chosen by the Akaike Information Criterion (AIC) and and are the disturbance terms. X is said to Granger- cause Y not only if 's are jointly significant but also if is significant. Similarly, Y is said to Granger- cause X not only if 's are jointly significant but also if is significant.

This equation system represents vector autoregression (VAR) in first differences, which also has error correction terms and allows examining the short run dynamics of the long run relationship among the considered variables. The coefficient of the error correction term must be seen as correcting towards and equilibrium subspace i.e. how adjustment is taken place in the short run to maintain stable equilibrium long run relationship among the considered variables. The coefficient of the lagged values of the variables show whether the independent variable causes the corresponding dependent variable (Ramos, 2001). The result of the causality tests are shown in table 4.

Table 4: Estimation of the Error Correction Models

Error Correction:	D(LGDP)	D(LGNS)
CointEq1	0.026054	1.47159
	[3.4855]	[5.5872]
D(LGDP(-1))	-0.04027	-0.65371
	[-1.9714]	[-9.0810]
D(LGDP(-2))	-0.18358	1.019805
	[-1.1776]	[1.9855]
D(LGNS(-1))	0.03822	0.281737
	[8.6266]	[1.9644]
D(LGNS(-2))	0.01916	0.16854
	[6.5946]	[1.9621]
C	0.13855	0.08754
	[4.1625]	[0.7464]

Note: Figures in the parenthesis represent 't' statistic
Source: Authors own formulations based on Eviews 7.0

Table 5: Pairwise Granger Causality Tests (Direction of Causality)

Sample: 1974 2010, Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
LGNS does not Granger Cause LGDP	35	5.40330**	0.00991
LGDP does not Granger Cause LGNS		18.0492*	0.00007

Note: * and ** denotes the rejection of the null hypothesis at the 1% level and 5% level respectively.

Source: Authors own formulations based on Eviews 7.0

The result error correction models and Granger causality models are explored in table 4 and 5. It can be seen that Granger test provides bidirectional causality from gross national savings to gross domestic product. The same is also true in the error correction models.

It is also clear from table 4 that both savings and output, respond to a deviation from long run equilibrium. The coefficient of the error correction term in both equations is statistically significant implying that both variables respond to the discrepancy from long run equilibrium. It is revealed from table 4 that the coefficient of the error correction term is not only statistically significant but also positive. That implication of the result is that changes in gross national savings causally affect gross domestic output in the short run.

5. Conclusion

The paper explores the dynamic causal relationship between gross national savings and gross domestic product in Bangladesh over a long period of time by applying Granger causality test, Johansen and Juselius cointegration test and Engel and Granger error correction models considering the stochastic properties of the variables. The main concentration of the paper is to address the issue of the short run dynamics of the savings and gross domestic product within a long run relationship. The estimated results show that both variables are nonstationary at their levels and stationary at first differences. Then using Johansen's cointegration technique it has been found that both the considered variables are cointegrated, implying that there is a stable long run relationship between gross national savings and gross domestic product. The error correction model shows that the considered variables drift apart in the short run. The study found bidirectional causality from savings to output. The result implies that savings can be an independent stimulus to the economic activity not only in the long run but also in the short run. The Granger causality test shows the same result. Therefore attempts have to be made to increase national savings so as to sustained increase in national output in Bangladesh.

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[1] This section draws heavily on Hossain, M.A (2011a).