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Article

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CONTROL CAUSALITY IN THE FINANCE-GROWTH NEXUS: Super-Exogeneity Test Evidence from SAARC Countries

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Abstract

This study utilizes concepts of super-exogeneity and control causality to examine the causal relationship between financial deepening and economic growth. For the assessment, the purpose study has explored data from South Asian countries, namely Pakistan, India, Bangladesh and Sri Lanka, for the period 1980-2018. Results indicate that financial deepening causes economic growth and the reverse is also true in the case of Pakistan and Bangladesh. This study provides evidence of super-exogeneity in the case of India and Sri Lanka that economic growth causes financial deepening while the reverse does not hold. Overall, causal directions in the finance-growth nexus of sample countries are mixed. Results imply that sample economies should prioritize financial reform over growth to accelerate the pace of financial restructuring and sustainable growth.

Keywords: Control Causality, Super-Exogeneity, Financial Deepening, Economic Growth, SAARC.
JEL Classification: O40, G10, C49.

I. Introduction

The last two decades of financial development are topical in academic literature; it plays a role in determining macroeconomic stability and sustainable economic growth in developing countries. The enormous and growing literature on this subject can be summarized under two main tendencies. The cross-country and panel data studies found a positive effect of financial development on output growth by controlling for potential biases induced by simultaneity, the omitted variables and the unobserved country-specific effects. The time-series studies offer an opportunity to analyze the causality pattern and its evolution over time between financial development and economic growth, finding unidirectional causality from finance to growth or bidirectional causality.

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The earlier work by Goldsmith (1969) confirmed the positive influence of the financial sector liberalization of a country on economic growth. In determining the causal relationship between the growth-finance nexus, Levine and King (1993), Rajan and Ziingales (1998) and Levine, et al., (2000), provide a supportive base for 'finance-led growth. The previous empirical works yield reliable findings consistent with the role of financial deepening in steady-state economic growth. Arestis, et al., (2001) found that financial depth had a strong effect on output growth, while causality exists between financial development and economic development in both directions.

Leahy, et al., (2001) argued that the stock market and financial institution development are correlated with economic growth. Levine, et al., (2000) and Beck, et al., (2000) assess the role of financial development in stimulating economic growth. Their results found that financial development had been robustly linked with economic growth and total factor productivity growth.

Al-Avad and Harb (2005) conclude that financial development and economic growth may be related in the long run. However, in the short run, the evidence of causality is fragile.

Ang and McKibbin (2007) argued that financial sector reforms have contributed to financial deepening in Malaysia and that financial development has not contributed to economic development. Ibrahim (2007) considered the role of the financial sector in Malaysia's economic growth; the empirical analysis shows that a long-run relationship exists between economic development, financial development and financial volatility. Odhiambo (2010) considered the causal link between financial development and economic growth in South Africa, concluding that economic growth has positively contributed to financial development in South Africa.

Anwar and Sizhong (2011) reveal that the level of financial development has positively contributed to the growth of domestic capital stock. Still, its impact on economic growth is statistically insignificant in Malaysia. An increase in the stock of foreign investment in Malaysia has contributed to an increase in the stock of domestic capital and economic growth. However, the stock of foreign investment is affected significantly only by the level of openness of the economy and its real exchange rate.

Jalil and Feridun (2011) determine a positive and significant relationship between financial development and economic growth in Pakistan. Anwar and Nguyen (2010) found a strong positive link between financial development and economic growth in Vietnam when alternative measures of financial development were used. The impact of foreign direct investment on economic growth will be stronger if more resources are invested in financial market development. Mohsin, et al., (2022) show that there is no clear consensus on the direction of causality between financial development and economic growth. All measures of financial development such as total financial system deposits to GDP (DEPGDP), private credit to GDP, private credit by banks to GDP (PRCGDP), credit to the private sector as a ratio to total domestic credit (CPS/DC) and liquid liabilities to GDP (M2/GDP). The study also observed that the

findings are country-specific to examine the causality in financial deepening and overall economic growth.

King and Levine (1993a,b) found a strong and robust correlation between financial indicators and economic performance, but their results also showed that government intervention in the financial system has a negative effect on the growth rate.

This study aims to examine if financial deepening control causes economic growth or vice versa for SAARC countries that have reforms in the financial system. The study is an effort to find an answer to the question, 'is bidirectional control causality between financial development and economic growth exist?'. However, the specific mechanisms that relate financial sector development to changes in the behaviour of economic agents are still a mystery. The question of causality is a long-standing problem, profoundly philosophical and raises all kinds of controversies. Given the practical importance of causality for control or policy purposes, using two available structural approaches to causality is desirable.

Moreover, the super-exogeneity concept is adopted in this study by providing the first empirical evidence that financial development control causes economic growth in a selected sample of countries. This required the concept of causality because the Granger causality methodology is weaker in the short run, i.e., Granger Causality does not indicate direction. On the other hand, control causality confirms the mode of direction with the help of the super-exogeneity test. Granger causality implies temporal predictability but does not deal with the issue of control and, thus, is unsuitable for policy analysis. Therefore, this study uses well-known tests for super-exogeneity to examine whether or not financial development control causes economic growth or vice versa.

The study is organized as follows: the next Section II provides the control causality in finance. Section III presents the empirical methodology and source of data used in the study. The empirical findings are presented in Section III and finally, Section IV concludes the research and provides the relevant policy implication.

II. The Control Causality in Finance–Growth Nexus: Super-Exogeneity Test

The newly revived causality idea, control causation, was earlier introduced by Simon (1953). The study considers control causality between financial deepening FD_t and economic growth (Y_t). In Simon (1953) 's sense, FD_t it causes Y_t if control of FD_t makes (Y_t) controllable.[1]

If (FD_t) causes (Y_t), then the data generation process may be as follows in Equations (1) and (2):

$$Y_t \beta FD_t + \zeta_t \qquad \zeta_t = N(0, \sigma_\zeta^2) \tag{1}$$

[1] For details Hoover (1990) and Hoover and Sheffrin (1992).

$$FD_t = \Pi + u_t \qquad u_t = N(0, \sigma_U^2) \tag{2}$$

The parameters of the income process are β and σ_ζ^2 and those of the financial deepening process are Π and σ_U^2.

A joint probability distribution between economic growth (Y_t) and financial deepening FD_t at time t can be split into a conditional distribution and a marginal distribution as follows [Equation (3)]:

$$D_j(Y_t, FD_t \mid Z_t ; \lambda_t) = D_c(Y_t \mid FD_t, Z_t ; \lambda_{1t})\, D_M(FD_t, \mid Z_t ; \lambda_{2t}) \tag{3}$$

Here D_j, D_C and D_M respectively refer to the joint density of (Y_t) and FD_t, the conditional density of (Y_t) given FD_t, and the marginal density of FD_t, Z_t represents a set of information including lag values of (Y_t) and (FD_t), as well as current and lagged values of other valid conditioning variables $Z_t = (Y_{t-l}^l, FD_{t-l}^l, Z_t')$. The parameter vectors are then labelled correspondingly λ_t, λ_{1t}, and λ_{2t}. These parameters may not be constant over time. Engle, et al., (1983) define FD_t it to be super-exogenous for λ_{1t}, if no loss of information about λ_{1t} from neglecting to model D_M (weak exogeneity of FD_t for λ_{1t}), and if changes in λ_{2t} do not imply changes in λ_{1t} (λ_{1t} is invariant to changes in λ_{2t}).

Simon (1953) identified the control causality as a property invariant to intervention in the data-generating process, which is represented only by the parameter changes. Because complete information from the data is impossible regarding causality within a single regime, we should now consider the regime change. From the bivariate joint normal distribution of (Y_t) and FD_t $D(Y_t \mid FD_t)$ is specified in Equation (4):

$$D(Y_t \mid FD_t) = N(\mu_Y^t + \theta_t (FD_t - \mu_{FD}^t), \eta_t) \tag{4}$$

Where $\vartheta_t = p_t\left(\frac{\sigma_Y^t}{\sigma_{FD}^t}\right)$, $p_t\left(\frac{\sigma_{Y,FD}^t}{\sigma_Y^t, \sigma_{FD}^t}\right)$, $\eta = \sigma_{Y,Y}^t (1 - p_t^2)$ on the other hand, $D(FD_t \mid Y_t)$ can be expressed similarly from the bivariate joint normal distribution of Y_t and FD_t with Equation (4); the resulting distributions can be obtained as follows:

$$D(Y_t \mid FD_t) = N(\beta FD, \sigma_\xi^2,)$$

$$D(FD_t) = N(\prod, \sigma_u^2,)$$

$$D(FD_t \mid Y_t) = N.\left\langle \frac{\beta\sigma_u^2 + \prod\sigma_\xi^2}{\beta^2 \sigma_U^2 + \sigma_\xi^2} \cdot \frac{\sigma_\xi^2 \sigma_u^2}{\beta^2 \sigma_u^2 + \sigma_\xi^2} \right\rangle$$

$$D(Y_t) = N(\beta\prod, \beta^2 \sigma_U^2 + \sigma_\xi^2)$$

Suppose Equations (1) and (2) are true, as mentioned above. In that case, that is (FD_t) cause (Yt), then structural changes in the financial deepening ($\prod$) and (σ_u^2) result in the instability of $D(FD_t)$, $D(FD_t|Y_t)$, and $D(Y_t)$, and the stability of $D(Y_t|FD_t)$. Structural changes in economic growth (changes in β and σ_{ξ}^2), though, result in the instability of $D(Y_t|FD_t)$, $D(FD_t|Y_t)$, and $D(Y_t)$, and the stability of $D(FD_t)$.

However, suppose (Y_t) caus Q 1es (FD_t), the corresponding results in the conditional and marginal distributions and stability conditions are reversed. In that case, the stability conditions in the control causality are closely related to parameter invariance. Ericsson, et al., (1998) pointed out that the concept of control causality is similar to that of super-exogeneity. Perez (2002) reveals that testing for super-exogeneity is more straightforward than the traditional methodology used in testing control causality.

From the above discussion, control causality from financial deepening to economic growth holds if the parameters (β and σ_u^2) of the conditional Equation (1) are constant with respect to changes in the parameters ($\prod$ and σ_{ξ}^2) of the marginal Equation (2).

III. Empirical Methodology

The conditional and marginal distributions can be interpreted as regression equations. Hoover (1990) and Engle and Hendry (1993) suggest the null hypothesis tests that FD_t are super-exogenous for β in the linear regression of (Y_t) conditional on FD_t (D_C in the main D_j equation), given that the error in the conditional equation is assumed to be normally distributed in Equation (5):

$$Y_t = \beta FD_t + Z'_{1t}\,\gamma + \zeta_t \;\; \zeta_t = N(0,\;\; \sigma_{\zeta}^2) \tag{5}$$

Hence Z'_{1t} ($\subseteq Z_t$) is represents all other conditioning variables and ζ_t is white noise and normally distributed, the parameterization of the marginal distribution of FD_t which follows as Equation (6):

$$FD_t = Z'_{2t} \prod + u_t \qquad u_t = N(0,\;\; \sigma_u^2) \tag{6}$$

where Z'_{2t} ($\subseteq Z_t$) include lag values of FD_t and other conditioned variables, as Z'_{2t} is assumed to allow for and define regime shifts in the data generating process FD_t; Finally, the test for super-exogeneity; hence control causality, constitutes the F-state for the exclusion of (u_t, u_t^2) as well as stable coefficients in Equation (5).

We allow the β as a variable, β^t and to simplify the analysis, it usually takes a linear approximation of $\beta^t\,\mu_{FD}^t$ the mean of the first term of the right-hand side in Equation (5) w.r.t μ_{FD}^t and $\sigma_{FD,\,FD}$ rather than a second-order approximation in Equation (7):

$$\beta^t\,\mu_{FD}^t = \beta\,(\mu_{FD}^t,\;\; \sigma_{FD,\,FD}^t)\;\mu_{FD}^t = \beta_0\,\mu_{FD}^t + \beta_1 \sigma_{FD,\,FD}^t \tag{7}$$

Subsequently, substituting the conditional mean of (Y_t) $\mu^t_{FD} = \beta_0 \mu^t_{FD} + Z'_{It}\gamma + \beta_1 \sigma^t_{FD,\,FD}$ in Equation (4) yields in Equation (8):

$$D(Y_t \mid FD_t) = N(\beta_0 FD_t + Z'_{It}\gamma + (\theta_t - \beta_0)(FD_t - \mu^t_{FD}) + \beta_1 \sigma^t_{FD,\,FD},\ \eta_t) \quad (8)$$

Now, the conditional equation of (Yt) for regression is as follows in Equation (9):

$$Y_t = (\beta_0 FD_t + Z'_{It}\gamma + (\theta_t - \beta_0)\,\hat{u}_t + \beta_1 \hat{u}^2_t + \xi_t) \quad (9)$$

Where $\hat{u}_t = FDt - \mu^t_{FD}$, $\hat{u}^2_t$ is used for the proxy of $(\sigma^t_{FD,\,FD})$. The weak exogeneity condition requires that $\theta_t = \beta_0$, and the invariance condition requires that $\beta_1 = 0$. The test of super exogeneity of (FD_t) for β, which is performed through the F-test of exclusion ($\hat{u}_t$ and $\hat{u}^2_t$) in Equation (9).

Moreover, if we consider the reverse causality from (Y_t) to (FD_t), similar equations (conditional and marginal) can be set up. The conditional equation for financial deepening can be written as [Equation (10)]

$$FD_t = \beta_0 Y_t\,(\beta_0 FD_t + Z'_{It}\gamma + (\theta_t - \beta_0)\,\hat{u}_t + \beta_1 \hat{u}^2_t + \xi_t \quad (10)$$

The last step in the empirical implementation of the test requires the parameterization of the conditional Equation (5) and the marginal Equation (6), as follows Equation (11) and (12):

$$D(Y_t \mid FD_t, R_1) = \Delta lnY_t = \alpha_0 + \sum_i \beta_i FD_{t-1} + \sum_i \vartheta \Delta lnY_{t-i} + dlnY_{t-1} + eFD_{t-1} + \sum_i \gamma_i R_{t-i} + \xi \quad (11)$$

$$D(FD_t \mid R_1) = \Delta FD_t = \alpha_1 + \sum_i C_i \Delta FD_{t-i} + fFD_{t-1} + \sum_i g_i R_{t-i} + u_t \quad (12)$$

Where R_t denotes the real rate of interest $(R_t = i - \pi^e_t)$ and $\pi^e_t = \pi_t$ that is a control variable to account for its effect on financial deepening and also to account for the contribution of investment to economic growth. The variables (FD_t) and (Y_t) are introduced at the level and difference in the spirit of the error correction form both for short and long-run effects in Equations (11) and (12).

To investigate the test procedure for super-exogeneity of (FD_t) for the parameters, $D(Y_t \mid FD_t, R_t)$ we insert (u_t and u^2_t) into Equation (11) and get the following Equation (13):

$$\Delta lnY_t = D(Y_t \mid FD_t, R_t) + h\hat{u}_t \text{ and } k\hat{u}^2_t \quad (13)$$

After introducing the dummy variables to account for structural changes or for policy interventions, ($\hat{u}_t$ and $\hat{u}^2_t$) are derived from the marginal equation. If the coefficient $\hat{u}_t$ is insignificant, then conclude that FD_t is weakly exogenous for the param-

eters of $D(Y_t \mid FD_t, R_t)$. If both coefficients ($\hat{u}_t$ and $\hat{u}_t^2$)are insignificant, then FD_t is super-exogenous for the parameters of $D(Y_t \mid FD_t, R_t)$. If the conditional Equation (11) is stable and *FD* is super-exogenous, then FD_t control causes Y_t.

1. Data

To estimate the conditional Equation (11) and marginal Equation (12) annual data are used for four selected SAARC countries; Pakistan, India, Bangladesh and Sri Lanka. This study covers the period from 1980-2019. To find out the control causality between economic growth (ΔlnY_t), and the degree of financial deepening/ deepening (FD_t), the study has measured the FD_t by taking the liquid liability to GDP ratio (M2/GDP). This variable equals currency plus demand and interest-bearing liabilities of banks and non-bank financial intermediaries divided by the GDP. It is the broadest measure of financial development used in the literature Beck, et al., (2009), Hassan, et al., (2011). While GDP growth, the real interest rate (R), is measured by taking the difference of the nominal interest rate and the current rate of inflation because people's expectations are equal to the actual. The data of all variables are collected from International Financial Statistics (IFS) database, which has internationally comparable time-series data.

IV. Empirical Findings

Equations (11) and (12) are first estimated on the bases of four lagged terms and variables (ΔlnY_t), and (ΔFD_t), which are introduced both at the level and first difference. Then the final equations, based on these initial estimation results, are reconstructed and re-estimated by choosing those significant terms based on the Hendry and Richard (1982) general-to-specific approach; the results of the final estimations are shown in Table 1.

1. Conditional Model of Economic Growth: ΔFD_t causing ΔlnY_t

Equations (11) and (12) are first estimated on the bases of four lagged terms for (ΔlnY_t), and (ΔFD_t) because the data is limited. The results of the final estimation for the conditional equation are shown in Table 1.

Firstly, it is necessary to find out if the exogenous changes in the financial deepening have any systematic influence on economic growth, both in the short and long run. In this regard, the focus is on the significant coefficients for ΔFD_t and FD_{t-1}; initially, the study found that the short-run effect of financial deepening on growth is negative for all countries, but the effect is statistically insignificant except for India. The contemporaneous and lagged effect of financial deepening on economic growth is positive and significant in the case of Pakistan and Sri Lanka. Also, find that all counters have a positive long-run effect which is significant only in the case of Bangladesh.

TABLE 1

Conditional Equation for Economic Growth ΔlnY_t

Explanatory Variables	Pakistan	Bangladesh	India	Sri-Lanka
Constant	0.87**	1.62*	0.19	0.15
	(3.29)	(0.62)	(0.11)	(0.08)
ΔFD_t	0.07	0.55	-0.62**	-2.34
	(0.002)	(0.25)	(0.21)	(0.42)
ΔFD_{t-1}	0.005**	0.006	0.22	2.01**
	(0.002)	(0.33)	(0.59)	(0.59)
ΔlnY_{t-1}	-0.14	0.08	0.60**	0.6
	(0.18)	(0.2)	(0.17)	(0.17)
ΔlnY_{t-2}	-0.24	0.24	-0.36	-0.33
	(0.19)	(0.19)	(0.14)	(0.14)
lnY_{t-1}	-0.04	-0.005	0.01	0.01
	(0.001)	(0.002)	(0.006)	(0.006)
FD_{t-1}	0.06	0.372**	0.08	0.69
	(0.001)	(0.15)	(0.35)	(0.35)
R_{t-1}	0.18	-0.002	0.0008	-0.0003
	(0.23)	(0.006)	(0.0009)	(0.0009)
R_{t-2}	-0.12	-0.00	0.002**	0.000
	(0.24)	(0.005)	(0.0009)	(0.0009)
R^2	0.52	0.51	0.61	0.65
LM(2)	3.77	0.01	5.18	4.33
	[0.15]	[0.99]	[0.06]	[0.11]
J B	0.86	14.68	1.85	1.54
	[0.64]	[0.00]	[0.55]	[0.46]
D1	0.6	–0.07	–0.004	0.002
	(0.81)	(0.009)	(0.01)	(0.01)
D2	-0.20	-0.20	-0.002	-0.020
	(0.80)	(-0.009)	(0.01)	(0.01)

Source: Authors' estimation.

Note:* and ** are significance 1 and 5 per cent levels, respectively.

LM: Breusch-Godfrey serial correlation test statistics on two lag ( ): heteroskedasticity and serial correlation consistent standard error [ ]: p-value.

A wide variety of theoretical models also suggest that financial deepening and improvements in financial systems can either boost or impede growth in the long run. For instance, Levine (2002) lists Hamilton, Bagehot, and Schumpeter, each putting forth a view for the positive effects of financial deepening on growth. He also lists two situations in which financial deepening and improvements in the financial system can upset long-term growth.

It discovers another interesting outcome by focusing on the significant coefficients for real interest rate (R). It noted a negative interest rate effect on growth for Bangladesh and Sri Lanka and a positive effect for Pakistan and India in the first year. However, in the second year, the interest rate is negative for Pakistan and Bangladesh and positive for India and Sri Lanka while significant only in the case of India. The above results indicate the p-value for Breusch-Godfrey (B-G) LM serial correlation test statistics at two lags show no serial correlation for the conditional equation for ΔlnY_t at the 5 per cent level of significance. The P-value and Jarque–Bera normality test show that the series is normally distributed for the conditional equation of economic growth. The overall direction and significance of regression coefficients are mixed. To test the control causality from financial deepening to economic growth, the stability for the conditional equation for ΔlnY_t, implement three stability tests, CUSUM of squares, recursive residuals, and recursive coefficients test. The graphs of CUSUM of squares and recursive residuals and their results are presented in Figures A-1 to A-4 in the Appendix. The case of examining the reverse causality from economic growth to financial deepening is presented in Figures B-1 through B-4 in the Appendix and will be discussed later. Briefly, the path of CUSUM of squares for Pakistan in Figure A-1 (Appendix) lies within a 5 per cent significance line and the path of recursive residuals breaks the lower band in 2009 and moves back in 2010. The paths of recursive coefficients for the conditional equation do not display significant variations or relatively stable patterns. Both tests indicate the stability in the parameters for the conditional equation. Thus the results of these three stability tests imply no structural break for the conditional equation. In the case of Pakistan, the graphs of the recursive coefficients are not presented hereafter for space consideration, but they are available upon request.

Several policy changes may have contributed to repeated regime shifts in the marginal equation for financial deepening. The study selected major policy intervention dates based on a summary of the main financial reforms discussed by Demetriades, et al., (2001). They are the interest rate liberalization of 1988, equity market opening and financial deregulation in the 1990s. The dummy variables are included in the marginal Equation (12) on the basis of visual inspection of the path of FD_t over time: D1=1 if year = 1988, D2=1 if year ≥ 1990 for Pakistan. The estimated coefficients for D1 and D2 are insignificant at a 5 per cent level, indicating no regime shift in those years. Thus, the financial reforms caused no structural breaks in the marginal equation for financial deepening because this was the starting period of financial liberalization in Pakistan.

In order to examine the control causality for India from financial deepening to economic growth, again execute three stability tests of CUMULATIVE SUM of squares, recursive residuals, and recursive coefficients test, whose results are presented in Figure A-2 in the Appendix. In Brief, the path of CUMULATIVE SUM slightly crosses the lower 5 per cent significance line in 2005, which is backed sharply within the 5 per cent significance line. The path of recursive residuals crosses the upper 2SE bands in 2005 and back to the two-SE bands and breakout from the lower band in 2011, both of which indicate unstable parameters for the conditional equation ΔlnY_t. Furthermore, the recursively estimated coefficients for the conditional equation display no significant variations. Therefore, the results of these three stability tests imply a structural break for the conditional equation and ΔFD_t does not cause the ΔlnY_t. Next, identified two structural breaks on the basis of a visual inspection of the path of economic growth over time. For some policy interventions that may have multiple regime shifts to this end, introduce two dummy variables in the marginal equation: D1=1 if year = 1991, D2=1 if year = 2000. Since the beginning of the 1990s, the Indian economy has been undergoing economic reforms, including financial sector reforms. Financial sector reforms mainly entailed reforms of the banking system and the capital market. With the interest rate deregulation, the Indian banking system has become more market-oriented since 1991. There has been a rapid expansion of the stock market activities as well. The estimated coefficients for the dummy variables are insignificant, indicating no regime shifts in the marginal equation for financial deepening in those years. The probability value for B-GLM serial correlation test statistics shows no serial correlation for the conditional equation for ΔlnY_t at a 5 per cent significance level. The prob.-value of the Jarque–Bera normality test shows the normality of the conditional equation for financial deepening at the conventional 5 per cent significance level.

To assess the control causality between financial deepening and economic growth in the case of Sri Lanka, the stability for the conditional equation for ΔlnY_t. Three stability tests are applied, CUSUM of squares, Recursive residuals, and Recursive coefficients test. The graph of CUSUM of squares and recursive residuals and their results is shown in Figure A-3 (Appendix).

The paths of CUSUM of squares break off the upper 5 per cent significance line in 2003 and revert to the lines in 2007 but seem to stabilize over time. Meanwhile, the parameters for the equation of economic growth are not stable, and the other two stability tests do not show the existence of instability, as evident by the recursive residuals staying inside the two -SE bands and the path of recursive coefficients displaying only minor changes. So the results of three stability tests are somewhat mixed, but it is safe and reasonable to conclude that the parameters of the economic growth equation are not stable, as long as at least one of the three tests, in this case, the CUSUM of squares test, shows any evidence of instability. Therefore, it is concluded that the financial deepening does not control or cause economic growth.

Thus the results of these three stability tests imply that there is no structural break for the conditional equation in the case of Sri Lanka. As before, the first step in checking the super-exogeneity is to examine whether or not there are structural breaks in the marginal equation for ΔFD_t over time. To do this, again introduce two dummy variables in the marginal equation: D1=1 if year=1983, D2=1 if year ≥ 2010. The estimated coefficients of D1 and D2 variables are insignificant, indicating no regime shift or a structural break in the marginal equation for financial deepening in those years. Since Sri Lanka fought the long civil war from 1983 to 2009, the economy grew at an average of 5.3 per cent during the period 2010-2019 [World Bank (2020)], reflecting a peace dividend and a determined policy thrust towards reconstruction and growth; although growth slowed down in the last few years. So the financial reforms have no significant effect on economic growth, as Sri Lanka started in 1977. The P-value for BG serial LM correlation test shows no serial correlation for the conditional equation for ΔlnYt at 5 per cent significance level. The probability value of Jarque–Bera normality shows that the series is normally distributed for the marginal equation of financial deepening at five per cent level of significance.

To study the control causality from FDt to ΔlnY_t, applying the same procedure for the stability of the conditional equation, ΔlnY_t, for Bangladesh. The study found that the path of CUSUM of squares within the limit of 5 per cent significance lines; and the path of recursive residuals showed large fluctuations and went outside the 2SE upper bands in 1999 and came back within the bands in 2001, then breakout lower 2SE band in 2002 and back to its limitation in 2003. The recursive coefficients show reasonably large changes in parameters in the earlier period, but they remain relatively stable in the remaining years. On balance, it finds the parameters of the conditional equation for economic growth are stable. These results lead us to conclude that financial deepening control causes economic growth. Given the evidence of parameter stability for the conditional equation indicating no structural break.

As the previous three stability tests, we need to check the super-exogeneity of FD_t for parameters of the conditional equation for these countries. The first step in doing this requires us to test the existence or absence of structural break in the marginal equation for ΔFD_t for Bangladesh. In this regard, the inclusion of dummy variables in the marginal Equation (10) based on visual inspection of the path of FD_t over time is done: D1=1 if year =1990, D2=1 if year ≥1990. The estimated coefficients of these two dummies D1 and D2 are insignificant, indicating no regime shift in the marginal equation for financial deepening in those years. For the marginal equation of financial deepening, several policy interventions may have contributed to multiple regime shifts.

The financial sector reform program (FSRP) was launched under the Financial Sector Adjustment Credit (FSAC) of the World Bank in 1990. The World Bank and USAID financed the program and the International Monetary Fund provided technical assistance. FSRP indicates that the reform measures were implemented satis-

factorily. But from the viewpoint of the desired outcome, the results were not very encouraging. Because 1990 is the initial period of reforms and 1997 is the starting period of the crisis.

2. Super-exogeneity of Financial Deepening

To further substantiate this finding, were implement tests for super-exogeneity of FD_t for the parameters $D(Y_t | FD_t, R_t)$ of the conditional equation for sample countries; we estimate and test the significance of $\hat{u}_t$ and $\hat{u}_t^2$ in Equation (12), and their outcomes are tabulated in Table 2:

The estimated coefficient $\hat{u}_t$ is significant and $\hat{u}_t^2$ insignificant at the 5 per cent level and the p-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is (0.003). It describes that the parameters of the conditional equation for financial deepening are found quite stable during the period of estimation from 1980 to 2018 Thus, its finding recommends that FD_t is weakly-exogenous for the parameters of the conditional equation. The stability of the conditional equation for economic growth and the weak-exogeneity of FD_t, can then be inferred that financial deepening control causes economic growth in the cases of Pakistan but is not yet strong. However, the estimated coefficient for $\hat{u}_t$ and $\hat{u}_t^2$ are significant at the 5 per cent level and the p-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is (0.005). It is that the parameters of the conditional equation for financial deepening are found not stable during the period of estimation from 1980 to 2018, Thus finding recommends that FD_t is weakly-exogeneity for the parameters of the conditional equation. The stability of the conditional equation for economic growth and the weak-exogeneity of FD_t, it can be inferred that financial deepening control causes economic growth in the cases of Bangladesh but is not yet strong. The estimated coefficient for $\hat{u}_t$ significant and $\hat{u}_t^2$ is insignificant at the 5 per

TABLE 2

Test for super-exogeneity of FD_t

Variables	Pakistan	Bangladesh	India	Sri Lanka
$\hat{u}_t$	0.006	0.880	0.950	1.023
	(0.002)	(0.132)	(0.21)	(1.57)
$\hat{u}_t^2$	0.0004	10.630	1.660	3.965
	(0.0006)	(4.45)	(15.95)	(54.39)
Joint F-test	3.80	3.61	5.25	3.41
	[0.003]	[0.005]	[0.100]	[0.006]

Source: Authors' estimation.

Note: ( ): heteroskedasticity and serial correlation consistent standard error, [ ]: p-value Joint F is statistics for the null hypothesis that the coefficients of $\hat{u}_t$ and $\hat{u}_t^2$ are zero.

cent significance level and the prob.-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is (0.10). Hence, the parameters of the conditional equation for economic growth are somewhat stable during the estimation period from 1980 to 2018. Thus our findings suggest that FD_t is weakly-exogenous for the parameters of the conditional equation. The instability of the conditional equation for economic growth and the weak-exogeneity of FD_t, can then be inferred that financial deepening does not control causes of economic growth in the cases of India.

The estimated coefficient for $\hat{u}_t$ and $\hat{u}_t^2$ are insignificant at the 5 per cent significance level, and the prob.-value for the joint F-test of excluding $\hat{u}_t$ and $\hat{u}_t^2$ is (0.006). Hence, the parameters of the conditional equation for economic growth are not stable during the estimation period. Thus our findings suggest that FD_t is supper-exogenous for the parameters of the conditional equation. The instability of the conditional equation for economic growth and the super-exogeneity of FD_t can also be inferred that the financial deepening does not control the causes of economic growth in Sri Lanka.

3. Test of Reverse Causality

Now examining the possibility of reverse causality from Y_t to FD_t, estimate the conditional equations of FD_t for the four SAARC countries, whose results are summarized in Table 3.

Again focus on the significant coefficients for ΔlnY_t in Table 3; find that the short-run effect of economic growth on financial development is significant and negative for all countries except Pakistan, which is statistically insignificant. As to its corresponding long-run effect from the coefficients for lnY_{t-1} it discovers only a positive significant effect for Pakistan. In contrast, the other three countries have a negative but insignificant effect in the long-run—the obtained mixed results for the interest rate effect on financial development. Turning to regression statistics, note that the p-value for B-G serial correlation LM test statistics shows no serial correlation for the conditional equation for ΔFD_t at a 5 per cent significance level.

Moreover, to test the control causality from economic growth to financial development, the stability of the conditional equation for ΔFD_t is examined. To obtain the robustness of the tests, as before, we perform three stability tests: CUSUM of squares, recursive residuals, and recursive coefficients. The graphs of the paths of CUSUM of squares and recursive residuals for the four SAARC countries are presented in Figures B-1 through B-5 (Appendix). Examining these figures, we first find for Pakistan and India, the path of CUSUM squares falls in the range of a 5 per cent significance line, the path of recursive residuals crosses the lower 2SE band in 1999 in the case of Pakistan and the sharp back to its limitations. While in the case of India, the path of CUSUM squares crossed the lower 5 per cent significance line in 1998 and stayed outside until 2001, while recursive coefficients also break out the 2SE bands in 2012 and 2016. Therefore, the parameters which indicate the conditional equation ΔFD_t

TABLE 3

Conditional Equation Financial Development ΔFD_t

Explanatory Variables	Pakistan	Bangladesh	India	Sri Lanka
Constant	130.35	-0.110	-0.001	0.039
	(43.66)	(0.420)	(0.090)	(0.025)
$\Delta \ln Y_t$	-0.79	-0.280**	-0.426**	-0.217**
	(0.76)	(0.121)	(0.126)	(0.043)
$\Delta \ln Y_{t-1}$	10.46	0.005	0.311**	0.178**
	(29.45)	(0.137)	(0.128)	(0.048)
ΔFD_{t-1}	0.24	0.274	0.417**	0.439**
	(0.21)	(0.210)	(0.210)	(0.1732)
$\ln Y_{t-1}$	8.82**	0.005	0.001	-0.001
	(2.96)	(0.015)	(0.007)	(0.0018)
FD_{t-1}	-0.37	-0.028	-0.021	-0.16
	(0.19)	(0.104)	(0.061)	(0.106)
R_{t-1}	-47.58	0.0003	0.0009	-0.0007**
	(61.81)	(0.003)	(0.0008)	(0.0002)
R_{t-2}	4.95	0.0002	0.0003	0.0003
	(6193)	(0.003)	(0.0009)	(0.0002)
R^2	0.55	0.30	0.44	0.64
LM(2)	4.63	0.21	5.67	0.46
	[0.09]	[0.74]	[0.004]	[0.53]

Source: Authors' estimation.

Note: ** 5 per cent level of significance respectively.

LM: Breusch-Godfrey serial correlation test statistics on two lag ( ): heteroskedasticity and serial correlation consistent standard error [ ]: p-value.

were found to be unstable. These results led us to the economic growth does not Control cause Financial deepening.

However, for Bangladesh, the path of CUSUM squares breaks out of the upper 5 per cent significance line at about 2003 and went back to the lines, while the path of recursive residuals went outside from the 2SE bands. In 2001 and reverts back to the 2SE bands in 2003. On balance, we find that the parameters of the conditional equation for economic growth are not stable. This is the clear direction that economic growth does not control, causing financial deepening.

Repeating the same procedure, the path of the CUSUM of squares for Sri Lanka lies within a 5 per cent significance line, and the path of recursive residuals is also within the two-standard error bands. These results then show the stability of the conditional equation for ΔFD_t for Sri Lanka. Additionally, the path of recursive coefficients with two-standard error bands shows relatively stable patterns. The results of these three stability tests imply that the conditional equation for Sri Lanka is found to be stable. Thus we conclude that there is evidence for control causality from economic growth to financial development in Sri Lanka.

V. Conclusion and Policy Implications

This study examined the causality between financial deepening and economic growth in four SAARC Countries (Pakistan, Bangladesh, India and Sri Lanka). These countries have experienced diverse economic growth and financial reforms in recent years and, as a group, make a good case study. What distinguishes this study from earlier empirical studies is the method of the causality test. Unlike earlier empirical studies, which relied essentially on the Granger-causality test, our study utilizes the concepts of control causality and super-exogeneity to examine the causal direction in financial deepening and economic growth. We find that in the case of Pakistan and Bangladesh, the financial deepening control causes economic growth, providing empirical evidence supporting the finance-growth nexus view in these countries. However, we did not find any evidence of reverse causality from growth to financial nexus in Bangladesh, while Pakistan found a mutual causality between financial deepening and economic growth. In the case of Sri Lanka, on the other hand, we find that economic growth control causes financial deepening, but the reverse is not true. We cannot determine the direction of causality between financial deepening and growth in India. Therefore, our overall finding as to the direction of the causal relationship in the finance-growth nexus from four SAARC countries is mixed. In evaluating the mixed results for the causal direction in the linkage between financial deepening and economic growth, we realize that we are in need of a macroeconomic analysis of the linkage between financial deepening and growth. In this regard, a promising area of research is a macroeconomic analysis of the linkage between financial deepening and economic growth.

The results of this study imply that a decisive and accelerated pace of restructuring can ensure sustainable economic growth in the medium or long term. This finding also sheds light on the current debate as to the policy priority between sustaining economic recovery and continuing with structural reform in the SAARC region. As it is known, the two economies of Pakistan and Sri Lanka are presently facing the unprecedented challenges of pursuing policies for economic recovery and current account deficit intensifying structural reforms simultaneously. Our findings confirm the validity of the view held by the World Bank and IMF and raise

serious questions about the 'growing out rather than restructuring out' strategy. Before a more definitive and general conclusion can be drawn on this issue, further research is needed. Therefore, it is highly desirable to expand the scope of the study to encompass a wide variety of countries.

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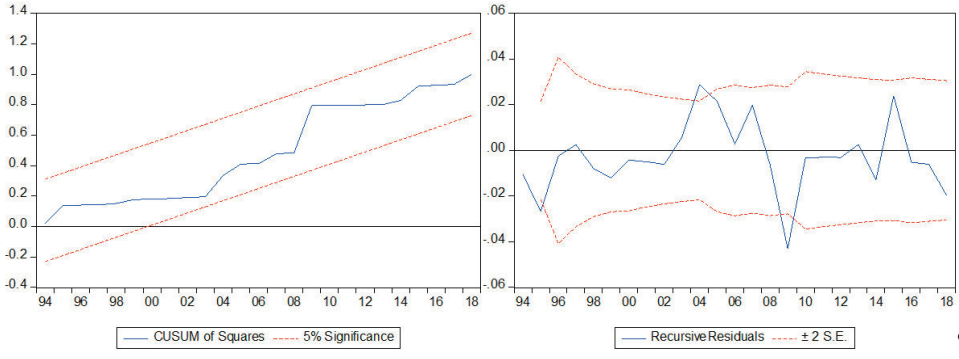
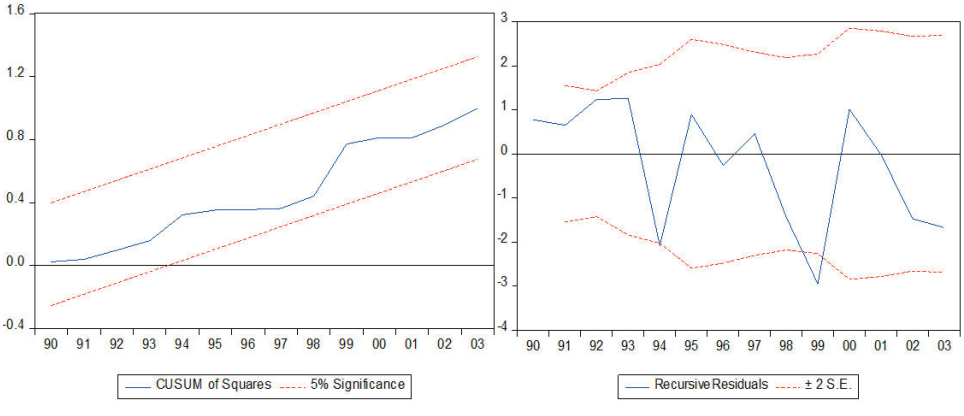
APPENDIX



CUSUM of Squares: ΔlnY_t Recursive Residuals: ΔlnY_t

FIGURE A-1

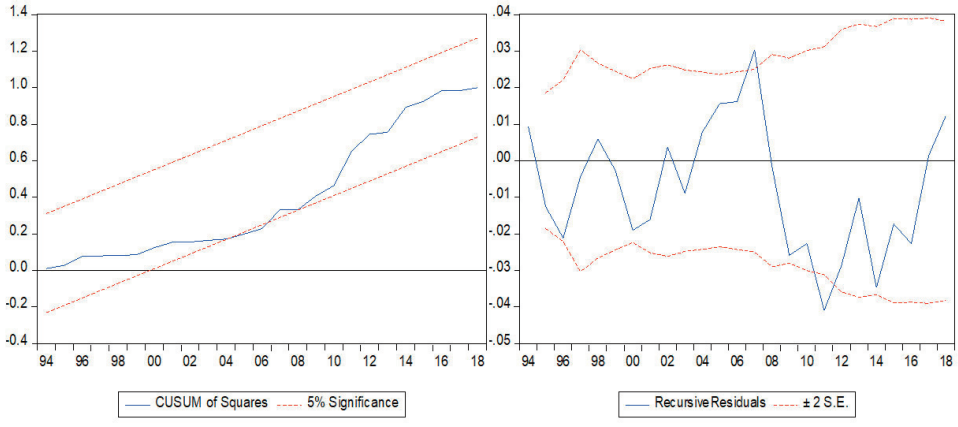
Stability Tests of Conditional Equation for Economic Growth – Pakistan



CUSUM of Squares: ΔFD_t Recursive Residuals: ΔFD_t

FIGURE B-1

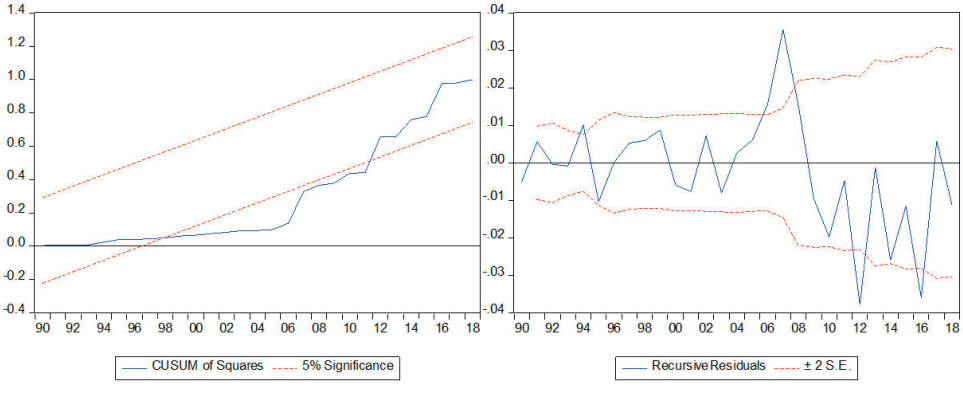
Stability Tests of Conditional Equation for Financial Deepening - Pakistan



CUSUM of Squares: ΔlnY_t Recursive Residuals: ΔlnY_t

FIGURE A-2

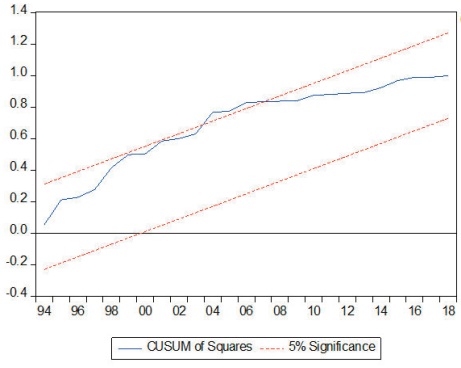
Stability Tests of Conditional Equation for Economic Growth – India



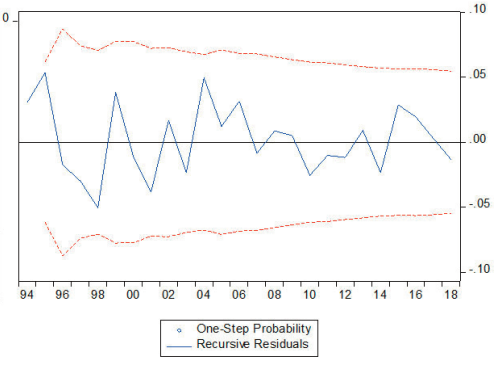
CUSUM of Squares: ΔFD_t Recursive Residuals: ΔFD_t

FIGURE B-2

Stability Tests of Conditional Equation for Financial Deepening - India



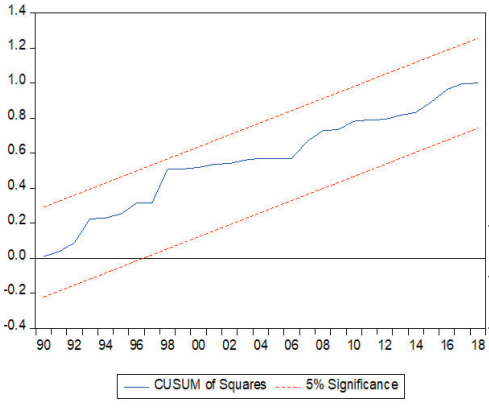
CUSUM of Squares: ΔlnY_t



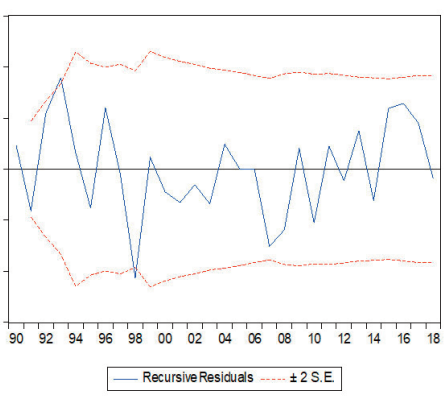
Recursive Residuals: ΔlnY_t

FIGURE A-3

Stability Tests of Conditional Equation for Economic Growth – Sri Lanka



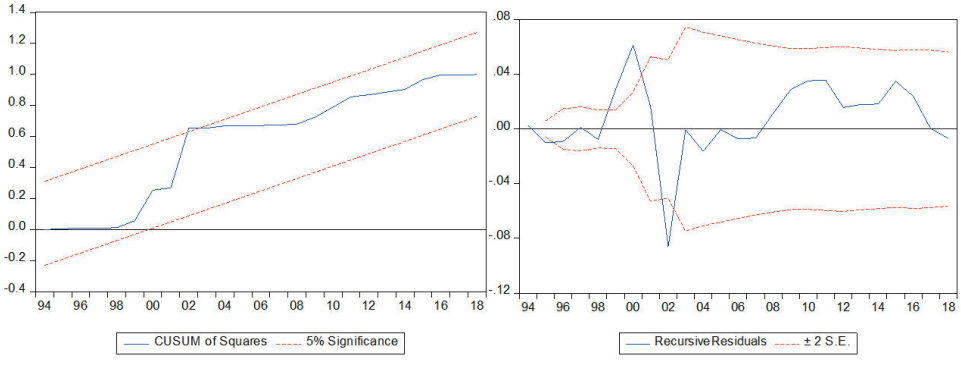
CUSUM of Squares: ΔFD_t



Recursive Residuals: ΔFD_t

FIGURE B-3

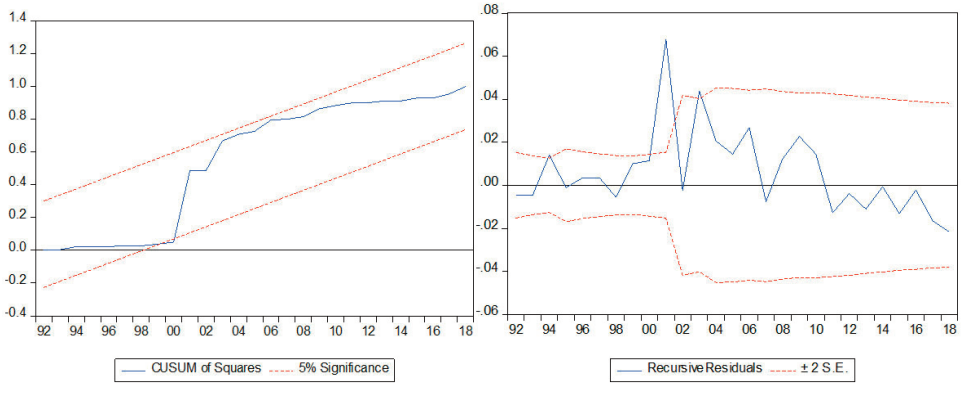
Stability Tests of Conditional Equation for Financial Deepening–Sri Lanka



CUSUM of Squares: ΔlnY_t Recursive Residuals: ΔlnY_t

FIGURE A-4

Stability Tests of Conditional Equation for Economic Growth – Bangladesh



CUSUM of Squares: ΔFD_t Recursive Residuals: ΔFD_t

FIGURE B-4

Stability Tests of Conditional Equation for Financial Deepening – Bangladesh