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Does Finance Matter for Innovation Led Growth? A South Asian Investigation

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***Abstract*:** Finance works as a frontier for the technological convergence and R&D activities that helps expedite the adaptation of new products and services which triggers the gales of innovations and hence leads towards innovation led growth. This research, thus, examines the moderating role of innovation in the finance-growth nexus in South Asia. To achieve this objective, a “balanced panel dataset” has been used for South Asian countries (Pakistan, Sri-Lanka, Nepal and India) for 1996-2018. The study considers financial depth, financial development and financial openness as predictors. Economic growth and innovation are utilized as outcome and moderating variables, respectively. The study applies dynamic ordinary least square to estimate the empirical results. Findings show significant positive impact of financial development and financial depth on economic growth. Whereas, financial openness shows insignificant impact on economic growth which becomes significant in the presence of innovation as a moderator. Innovation plays an enhancing role in the relations among financial development, financial depth, financial openness and economic growth. The findings suggest that the government of South Asia should increase R&D spending and issue more patents to promote innovation activities that lead towards innovation-led growth. The study recommends increasing investment in innovation by empowering financial institutions and organizations.

Keywords: Innovation; Financial development; Financial depth; Financial openness; Economic growth, Digital era.

1. Introduction

In the recent years, various researchers and policy makers have shown their mounting interest in exploring the key factors of economic growth (EG) in this digitalized world (Ullah et al., 2023). Schumpeter (1911), an early philosopher, has theoretically proved that the economic progress of a state is contingent with the financial market intricacy, which permits the effectual allocation of financial resources to boost up the innovative economic productivity. This theoretical contributions of Schumpeter opens up the way for different researchers to contribute empirically and theoretically to the finance-growth literature, this nexus remains the center of global attention, especially for emerging economies.

Researchers documented that a vibrant and well-built financial system plays an imperative role in promoting EG. Levine (2005) enlisted three networks through which a well-established financial system contributes to a nation's economic progress: 1) by combining and assembling savings for investments in order to reduce the financial contacts (Sirri & Tufano, 1995; Tahir et al., 2018) 2) by creating and processing evidence for the effective and efficient allocation of capital to the most lucrative firms (Boyd & Prescott, 1986) and 3) by providing the means of innovation in the real sector that works as an incentive for the dynamic economic progress (Fagiolo et al., 2020).

Aghion et al. (2009) stated that financial development (FD) works as a frontier for the technological convergence and R&D activities that helps to expedite the adaptation of new services and products which triggers the gales of innovations and hence leads towards the innovation led growth. However, the innovation process is long, eccentric, peculiar and capricious with many financial constraints. Therefore, the financial openness (FO) is regarded as a significant solution to deal with these financial constraints (Tahir et al., 2021; Bekaert et al., 2011). For instance, the openness of financial system provides the foundation to be more unified with the global financial system which helps the inflow of foreign capital in the home state, and hence opens up the smooth ways of different innovation activities (Huo et al., 2022; Bhutta et al., 2022). Alike FO, financial depth (FDT) also expedites the nation's EG as it enables the financial integration of the unbaptized population into a formal financial system by offering different financial services and investment opportunities (Ivanov et al., 2019).

Nevertheless, researchers documented the strong association between finance-growth nexus. Literature also posits that a nation's financial sector positively contributes to the innovation and EG. But the question "does finance really matter for innovation led growth?" is still unanswered, because there exists a serious argument that either the capital provided by different financial system is really employed for innovational or R&D activities? The answer of this is probably not. It is, therefore, imperative to scrutinize the moderating role of innovation in finance-growth nexus to answer the former question, as the allocation of capital is useless, if it is not invested in some productive or innovational usage (i.e., in the R&D activities) (Zhu et al., 2020). Thus, the study aims to analyze the impact of FD, FDT and FO on the EG with the moderating effect of innovation in South Asian countries.

After examining the existing debate on finance-growth nexus, we figure out that several researchers have scrutinized the role of different financial indicators (such as FDT, FD and FO) in the EG of a republic. However, there is a lack of clarity in explaining the role of finance in innovation led growth. Interestingly, researchers have theoretically discussed positive role of finance towards innovational activities that resultantly leads towards the innovation led growth. But none of the researchers have empirically proved this, and hence the question "does finance really matter for the innovation led growth" leftover unanswered. To the best of our knowledge, finance-innovation led growth nexus has not been studied as rigorously and thoroughly as its importance has been discussed in the literature. Present study believes that there is still a great deal of work has done in this area for in-depth understanding on this issue. This study, therefore, contributes by integrating innovation as a moderator in the relation between finance and EG with the intend to empirically answer the former research question.

There is no doubt that literature evident the positive role of a country's financial sector in promoting the innovation and growth, but the question, does finance really matters for the innovation led growth needs to be answered for the region of South Asia for the following reasons: First, this region receives limited attention in the finance-growth nexus by the previous researchers. Second, its financial sector is a key contributor in accelerating its growth rates. An upward trend in the growth rates of this region has been observed in the recent years due to financial liberalization (Zakaria & Bibi, 2019). But, this region still thrives for innovation-led-growth. This situation creates many questions in the minds of authors: First, if finance is not invested in innovation, then where does it go? Or if it is invested in the innovation, then why the region still thrives for the innovation-led growth? Why we cannot see the innovation in real senses? To clear the ambiguities regarding all these questions, there is a dire need to conduct the study in the context of South Asia.

The rest part of the paper is divided as following: next section is about the empirical and theoretical review with hypotheses construction, section three details the research and econometric methods, while section four and five contains empirical results and conclusions, respectively.

2. Literature Review

2.1 Financial Development (FD) and Economic Growth (EG)

There exists an extensive literature on FD-EG nexus. Many researchers concluded the positive tradeoff between FD and EG after the findings of Schumpeter (1912), who theoretically proved the positive role of FD on the EG of a country. Schumpeter (1912) figured out that a developed system of finance is pre-requisite for FD as it helps allocating the finance efficiently for the dynamic innovation activities. These findings of the Schumpeter (1912) paved a way for the researchers to dig out the part of different financial activities in EG, and hence the debate amongst researchers has been started. It has been observed that the findings of several researchers were consistent with the theory of Schumpeter (1912). For instance, Hassan et al. (2011) argued that a developed system of finance works as a bridge for the nation's EG as it provides the means for the competent resources allocation to the prolific innovational activities. Acaravci et al. (2009) stated the two-way casual linkage between FD and EG for the case of 34 developing economies. Similarly, Zhang et al. (2012) also found positive link between FD and EG, which is beautifully defined by Supply-led and demand-led hypotheses. Tariq et al. (2020) worked under the theoretical lenses of endogenous growth theory, which postulates the capital as an essential source for the economic development, and documented the positive affiliation between FD and EG. According to the research, an established financial structure improves EG by facilitating the mobilization of savings, lowering the barriers to risk management, and streamlining the exchange of products, services and contracts. Wu et al. (2020) claimed the positive role of FD in the EG across major Asian economies. Author stated that a developed financial system provides different financial resources to inject the innovation resources in the economy, and hence build a road towards the nation's economic progress. Summarizing the above debate, we postulate that:

H_1: There exists a positive trade-off between financial development and economic growth.

2.2 Financial Openness (FO) and Economic Growth (EG)

Literature documented the efforts of several researchers regarding the nexus between FO and EG, however, the studies on the role of FO in EG are scare, as most of the researchers have aligned the openness of finance with the growth of the financial segment. For case, Bhutta et al. (2022) argued that as financial system develops, it becomes more opened to the foreign capital and hence become more unified with the global financial systems which triggers the gales of capital formation in the home nation, and hence contributes to the economic progress. However, this has been a controversial point widely discussed in the literature. For example, Oyovwi and Eshenake (2013) reported that it is FO which promotes FD. However, authors believed that both FO and FD collectively contributes to the EG. Gabriel and David (2021) conducted their research across Sub-Saharan African region with the intend to investigate the role of FO in the EG and found a significant association between these variables. Bekaert et al. (2011) stated that FO makes the provision to the external finance through enhanced running of internal system of finance through increased rivalry and cross-border provision of financial services. This provision of external finance is critically beneficial for the EG of developing economies that are facing different financial constraints. Kim et al. (2012) tested the dynamic impact of FO on the macro-economic uncertainty and EG by using the heterogeneous panel data for 1960-2007. Results exhibited a favorable link between FO and EG, while the negative affiliation between FO and macroeconomic uncertainty. Findings concluded significant contribution of FO in EG of the selected nations. Juravle (2020) also highlighted the crucial role of FO in the EG. Author documented that the FO excites the accretion of capital which is valuable for the EG. Summarizing the above debate, we assume that:

H_2: There exists a positive nexus between financial openness and economic growth.

2.3 Financial Depth (FDT) and Economic Growth (EG)

Finance-growth nexus has been the topic of pivotal interest of numerous researchers for a considerable period of time for the case of developing and emerging economies. A number of researchers have documented that financial system of an economy facilitates the economic progress of a country (Levine, 2003; Levine, 2005; Demetriades & Andrianova, 2004). Different growth theories i.e., endogenous growth theory, new classical theory, demand-led and supply led hypotheses also confirm these findings with several theoretical justifications. However, despite the fact that the relation of growth and finance is well-documented in the available works, the casual linkage between FDT and EG is still controversial. For instance, one strand of researchers has documented the two-way causality between FDT and EG in the light of "feedback hypothesis" (Pradhan et al., 2013; Mukhopadhyay et al., 2011), while others documented the one-way causality (from FDT to EG) in the light of "neutrality hypothesis" (Wolde-Rufael, 2009). However, both strands of researchers collectively agreed on a point that there exists a significant tie between FDT and EG. As Klein and Olivei (2008) stated that FDT boosts up the nation's EG through a well-operating financial system which makes the provision to different financial sources. Jedidia et al. (2014) argued that FDT stimulates the EG by endorsing saving and the investment funds, which resultantly provides the means of technological advancements and hence promotes EG. Odhiambo (2008) also documented the significant affiliation between FDT and EG. The results showed that EG concentrations increased with increasing FDT concentrations. As a result, we propose that:

H_3: There exists a positive association between financial depth and economic growth.

2.4 Innovation (IN) and Economic Growth (EG)

The literature is rife with research that have demonstrated a favorable correlation between IN and EG. Such as, Nair et al. (2020) took data from OECD economies with the aim to analyze the empirical relationship between IN and EG. Results of the study suggested that IN works as a stimulator for the EG. Similarly, Rajapova (2020) found the positive linkage between IN and EG for the case of Uzbekistan. Nomaler et al. (2021) did marvelous work. Author conducted their study under the framework of Schumpeterian model and estimate “R&D based productivity growth”. The research found that IN significantly contributes to a country's productivity. Law at al. (2020) empirically tested the role of IN in EG of Malaysia and found EG of the nation is significantly predicted by R&D activities. When looking at the situation in Azerbaijan, Ismayilov et al. (2021) came to quite similar conclusions. Wang and Zhang (2020) tested the influence that R&D expenditures have on the EG of BRICS economies, which implies that the higher the IN the higher will be the growth. Opoku-Mensah et al. (2021) conducted their research for the case of China and investigated the role of R&D expenditures and ICTs on EG. The findings conclude a direct relation amongst ICTs, R&D and EG. Hence, we propose that:

H_4: There exists a positive association between innovation and economic growth.

2.5 Innovation (IN) as Moderator

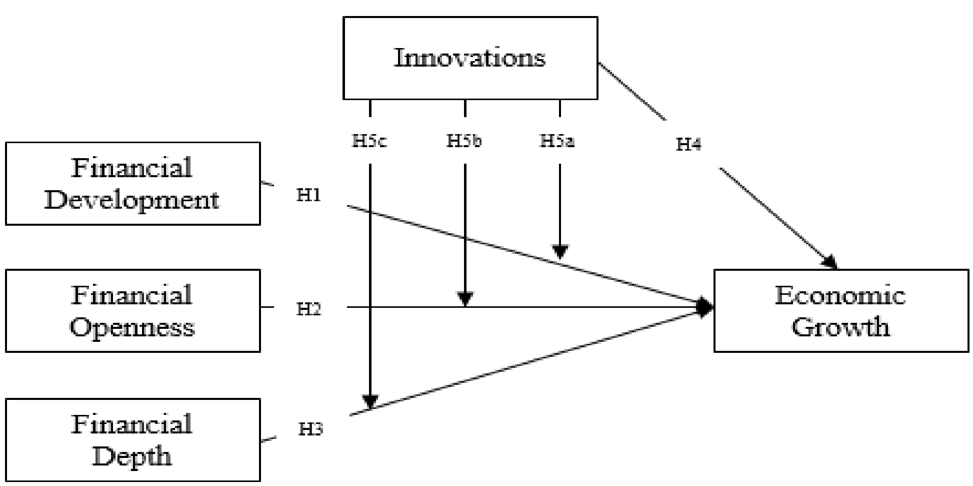
In Schumpeterian economics, innovation plays a crucial role in a nations’ economic progress, specifically, through its role in promoting the process of creative destruction (Schumpeter, 1912). However, a well-established financial system is essential for the effectual resources’ allocation for the dynamic innovational activities (O'Sullivan, 2005), which resultantly contributes to the innovational economic development. There is no doubt that the advanced and well-established financial markets provide the foundations for the allocation of finance which is crucial for the economic progress. However, this allocation of finance is useless, if it is not invested in some productive or innovational usage (such as R&D activities) (Zhu et al., 2020). Present study therefore perceives that innovation plays a momentous moderating role in the nexus between finance and EG. Hence, present study postulates that:

H_{5a}: Innovation moderates the relationship between financial development and economic growth.

H_{5b}: Innovation moderates the relationship between financial openness and economic growth.

H_{5c}: Innovation moderates the relationship between financial depth and economic growth.

2.6 Theoretical Framework



Our research is performed under the theoretical lenses of the “Schumpeterian model of economic growth”, and “neo-classical theory” to expect the significant linkage among the variables of interest. According to the

Schumpeterian model of EG, since innovations are at the heart of economic transformation, they are essential to business success (Schumpeter, 1934). However, an effectual and proficient allocation of financial resources is required to promote the innovation led growth (Freeman, 1994). R&D expenditures, technological transfer and interacting have been recognized as essential factors to promote the innovation, and henceforth innovation-led growth (Love & Ropper, 1999). However, this is not possible without a sound financial system. Literature has witnessed several implications of sound financial system in the innovation and growth, or in other words, innovation led growth, supported by the neo-classical theory. The theory specifies that a developed financial sector enables the innovation activities by reducing the credit constraints in the inflow of capital and hence provides the means to promote R&D financing (Brown et al., 2009), which resultantly contributes to the innovation-led growth. Moreover, conceptual framework of the study is depicted in Figure 1.

3. Data and Methodology

3.1 Data and variables

A "balanced panel dataset" covering the years 1996-2018 for four South Asian nations (Pakistan, Sri Lanka, Nepal and India) was employed to accomplish the study's goals. The selection of the time frame is determined by the quantity and quality of available information. However, due to a lack of data, we were unable to include the other nations in the region in our analysis. The data are obtained from world development indicators (WDI). The study considers FDT, FD and FO as predictors. EG (innovation) is utilized as outcome (moderating) variable. All relevant variables and their proxies are listed in Table 1.

Table 1: Variables and Measurements

Variables	**Proxy/Measurement**	**Reference**
Explained Variable		
Economic Growth (EG)	GDP per capita (Constant 2015 US$)	Ahmed et al. (2021)

Table 2: Variables definitions

Explanatory Variable		
Financial depth (FDT)	Money supply (M2) / GDP	Manu et al. (2011)
Financial development(FD)	Domestic credit to private sector (% of GDP)	Ahmed et al. (2021)
Financial openness (FO)	Foreign direct investment (FDI) / GDP	Gabriel & David (2021)
Moderating Variable		
Innovation (IN)	Number of patents by residents per thousand population	Pradhan et al. (2016)

3.1 Empirical model

The following equation (1) is used to assess the impact of innovations and finance on the EG:

$EG_{it} = \text{f}(FD_{it,} FDT_{it}, FO_{it}, IN_{it})$--- (1)

Where: EG: economic growth, FD: financial development, FDT: financial depth, FO: financial openness, IN: innovation for country *i* at time period *t*.

The innovation and EG variables have transformed into logarithm natural because they were not in the ratio or percentage unit. Capturing the moderating effect through the interaction term is a typical technique in the ongoing discussion (Aibai et al., 2019). Therefore, the research adheres to a similar trend by establishing several interaction variables to fully represent the moderating impact of IN on the finance-growth nexus though, the empirical models have the primary forms as follows (equation 2-5):

$lnEG_{it} = f(FD_{it,} FDT_{it}, FO_{it}, ln\ IN_{it})$--- (2)

$lnEG_{it} = f(FD_{it,} FDT_{it}, FO_{it}, lnIN_{it}, FD_{it} * lnIN_{it})$--- (3)

$lnEG_{it} = f(FD_{it,} FDT_{it}, FO_{it}, lnIN_{it}, FDT_{it} * lnIN_{it})$--- (4)

$lnEG_{it} = f(FD_{it,} FDT_{it}, FO_{it}, lnIN_{it}, FO_{it} * lnIN_{it})$--- (5)

Where; ln denotes to the transformation of log for the variables which were not in the form of fraction or percentage, and $FD_{it} * IN_{it}$, $FDT_{it} * IN_{it}$, and $FO_{it} * IN_{it}$ denote interaction terms of innovation. Present study formulates a separate equation for the interaction term to take high degree of freedom (*n*-*k*), where *n* is total number of observations, and *k* is total number of explanatory variables in an equation.

3.2 Econometric Techniques

3.2.1 Cross-Sectional Dependency (CSD)

Panels of economies from different regions show signs of CSD as globalization continues to strengthen its grip on the global economy, hence doing a CSD test on the panel is essential. To that end, we conduct an analysis using the CSD test to diagnose issues with panel estimating and check for efficient, effective and consistent panel estimators. The current research makes use of the Breusch and Pagan (1980) CSD test, which is one of several available in the existing literature that can be used to detect CSD. The panels with high N and low T values are the ones that should be put through this test (Ahmed et al., 2021).

3.2.2 Panel Unit Root Test

To defend the CSD test in panel data sets, first-generation panel stationarity tests have all failed. In order to alleviate the need to assume stationarity, this research uses a unit root test of the second generation. The lm, Pesaran, and Shin (CIPS) unit root test is a second-generation method for determining the order of integration (OI) in a series. These tests of the panel unit root have superior robustness and performance than other methods and they do not rely on the assumption that “(N → ∞).”

3.2.3 Panel Co-Integration Test

It is crucial to look into the long run relations between the series before looking at the OI of study variables. Westerlund (2007) devises an error correction model (ECM) as a co-integration test for this purpose. This ECM analysis takes into account CSD issues and the diversity of slopes. It allows for a wide variety in the robustness ranks of predictors because it is heavily dependent on historical data on a domain of series OI. Therefore, ECM is typically used wherever possible. This method is a “discretionary bootstrap process” that allows for iterative long-run tests of co-integration. Equation 6 demonstrates the ECM test's requirements.

$$\Delta lnEG_{it} = \beta_{0i} + \sum_{i=1}^{q} \beta_i \Delta lnEG_{i,t-i} + \sum_{i=1}^{q} \varphi_i \Delta X_{i,t-i} + \gamma_i ECM_{i,t-i} + e_{it} \text{---} \quad (6)$$

Where; lnEG: log of economic growth; X: vector of predictors, γ_i: error term’s speed of adjustment.

3.2.4 The Estimations of Long Run

Long run factor estimations are made before the long run linkages among the series are confirmed. We use the dynamic ordinary least square (DOLS) test to foresee the effect of predictors on the EG and to reflect the moderating effect of IN at the intersection of finance and growth. This technique can capture the serial correlation since it allows for asymptotic consistency. DOLS is used, but only if co-integration between series is found to exist. From Equation 7 we may derive the DOLS estimations.

$$Y_{it} = \alpha_i + \acute{X}_{it}\delta + \sum_{j=-q_1}^{j=q_2} L_{ij}\Delta X_{it+j} + \mu_{it} \_\_\_\_ \quad (7)$$

Where; Y (X) denotes outcome (predictors’ vector); L_{ij} indicates the lag coefficients of regressors at I(1).

4. Results and Discussion

4.1 Descriptive Statistics and Multicollinearity

The statistical summary of the study variables is presented in Table 2 which reports the means and Std. Dev. of all the variables along with the largest and smaller values of the data. The values of skewness and kurtosis are also reported in this Table. The correlation among variables are presented in Table 3. Results illustrate that there is no “multicollinearity” as there exists an equitable correlation ($r < 0.70$) among the explanatory variables of the study.

Table 2: Descriptive Statistics

Particulars	***ln*EG**	**FD**	**FO**	**FDT**	***ln*IN**
Mean	7.1687	34.2694	0.1525	7.8710	8.1668
Median	7.1274	30.6706	0.1313	7.7251	8.1007

Maximum	8.3488	69.8408	0.5174	13.854	10.3625
Minimum	6.2662	15.3860	-0.0154	4.0813	5.7137
Std. Dev.	0.5238	12.6788	0.1130	2.2450	1.1191
Skewness	0.4039	0.6473	1.2203	0.3834	-0.0053
Kurtosis	2.6091	2.7083	4.7146	2.4282	2.5734

Table 3: Test of Multicollinearity: Pearson's Correlation

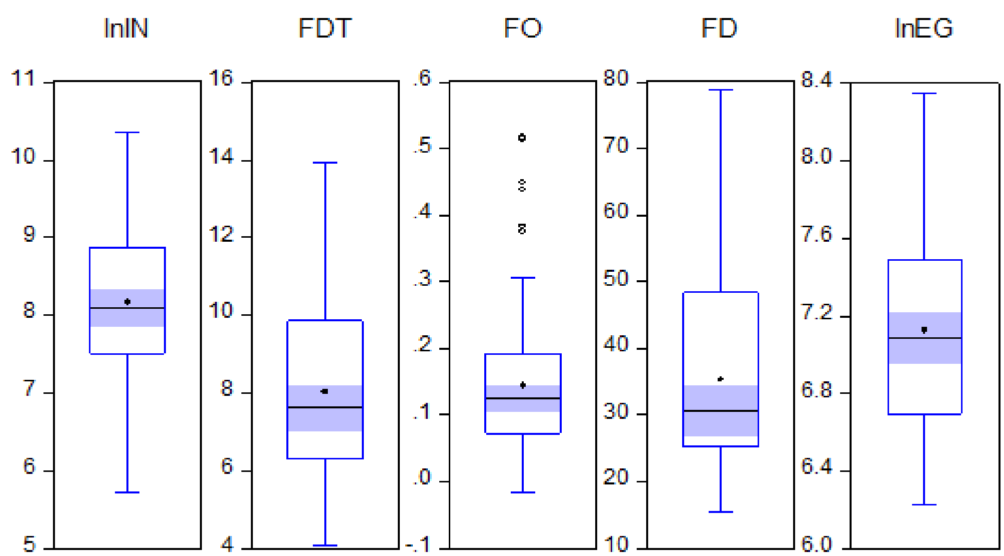
Variables	***ln*EG**	**FO**	**FD**	**FDT**	***ln*IN**
*ln*EG	1.0000				
FO	0.3289	1.0000			
FD	0.1058	0.1919	1.0000		
FDT	-0.4473	0.0515	0.3005	1.0000	
*ln*IN	0.3133	0.5273	0.2743	0.3199	1.0000

4.2 Normality of Data

Assessment of data's normality is essential to get unbiased, efficient, effective and consistent results. Concerning this, Jarque-Bera (JB) test was employed, outputs are reported in Table 4. Results portray that the data for FDT and *ln*IN are distributed normality (indicated by insignificant p values), while there exists issue of "non-normality" in the series of *ln*EG, FD and FO (shown by significant p values). As we can see that two out of five variables suffer from the issue of non-normality, we proposed that there exists normality issue in the data. However, before reaching at a final conclusion, we took graphical support to cross-check the findings. In this regard, box-plots have been used. Outcomes of box-plots are illustrated in Figure 2. According to the outcomes of box-plot (Figure 2), only the series of *ln*IN is symmetrical (i.e., normality distributed), and the other series suffer from the non-normality issue. Taken together, these results suggest that there exists the issue of non-normality, which signposts the existence of CSD. The test of CSD is therefore crucial.

Table 4: Test of Normality

Variables	**Jarque-Bera**	**p-value**
*ln*EG	2.7857*	0.0830
FD	6.0915**	0.0475
FO	30.769***	0.0000
FDT	3.1639	0.2055
*ln*IN	0.6295	0.7299



Note: "*, **, and *** represents the level of significance at 10%, 5% and 1%, respectively."

4.3 Cross Sectional

Figure 2. Box-Plots

Dependency (CSD)

As the results of normality tests indicate, CSD is a prevalent problem with panel data. Having a reliable test for spotting this issue is, thus, essential. At first glance, we apply "Breusch-Pagan LM" test to detect the problem of CSD and the existence of CSD produce unfair outputs. Results of this test are illustrated in Table 5, signifying that there exists the problem of CSD in the dataset. Specifically, all the series (e.g., *ln*EG, FD, FO, FDT and *ln*IN) are significant. This means that a single country's shock can have a significant impact on the results for the rest of the nations in the sample. Though, second-generation methods are recommended.

Table 5: Cross Sectional Dependency

Variables	**Breusch-Pagan LM**	**p-value**	**Decision**
*ln*EG	38.3044***	0.0000	
FD	54.8233***	0.0000	*"Cross-section dependence exists"*
FO	14.8696**	0.0213	
FDT	42.11688***	0.0000	
*ln*IN	57.4128***	0.0000	

Note: **, and *** represent the level of significance at 5% and 1%, respectively

4.4 Stationarity Properties of Data

We first confirm the presence of CSD in the data and then we check the research variables' stationary qualities using CIPS. The test is applied at level (first difference: 1^{st} Δ). Outputs are listed in Table 6, showing that all the sequences agonize from the problem of unit root at level in both circumstances (i.e., with and without trend). Besides, all the series become significant at the level of 1% when the test is applied after taking the 1^{st} Δ of the series. Outputs indicate that the series are integrated at 1^{st} order, i.e., I (1).

Table 6: CIPS: Second Generation Unit Root Test

Variables	**Level**		**First-Difference**		**OI**
	Without trend	**With trend**	**Without trend**	**With trend**	
*ln*EG	-1.0375	-1.2643	-5.3856***	-4.3875***	*I(1)*
FO	-1.6507	-1.0039	-3.2457***	-5.3734***	*I(1)*
FD	-1.9635	-1.724	-6.0364***	-5.0534***	*I(1)*
FDT	-1.0284	-1.1064	-8.4872***	-3.2246***	*I(1)*
*ln*IN	-2.736	-1.9224	-5.2765***	-3.9642***	*I(1)*

Note: *** represent the level of significance at 1%

Test of co-integration

Once the OI has been determined, a suitable test can be applied to verify the existence of a long run connection between the variables of interest. In order to determine "whether variables move together over the long run or not", we use Westerlund's (2007) second generation co-integration test. It is run four times, once for each model. Table 7 shows that the null hypothesis of "no-co-integration" is decisively rejected by the statistics. This verifies the presence of a co-integration relation between the chosen series for the South Asian region throughout the period 1996–2018.

Table 7: Westerlund (2007): Second Generation Co-Integration Test

	Model 1		Model 2		Model 3		Model 4	
	Statistic	*R.P.V*	*Statistic*	*R.P.V*	*Statistic*	*R.P.V*	*Statistic*	*R.P.V*
Gt	-5.7364**	0.0313	-4.8443**	0.0456	-2.7644	0.7433	-5.7345**	0.0355
Ga	-11.6634***	0.0000	-8.8374***	0.0000	-14.7384***	0.000	-6.8753**	0.0284
Pt	-8.9764***	0.0053	-6.0024**	0.0396	-9.9274***	0.0000	-11.0264***	0.0014
Pa	-9.9274***	0.0000	-3.7253*	0.0846	-8.9385**	0.0232	-14.9375***	0.0000
Decision	"cointegration exists"		"cointegration exists"		"cointegration exists"		"cointegration exists"	

Note: **, and *** represent the level of significance at 5% and 1%, respectively

Dynamic Long Run Estimates

The estimation of the long-run system dynamics comes last in the process of estimation. The present study employs DOLS to predict the dynamical long term estimates between the chosen variables. Models 1-4 show DOLS results generated from equations 2-5. Model 1 represents the estimates of the main model whilst model 2-4 capture the moderating influence of IN on finance-growth nexus. Specifically, we answer our research question here, "does finance really matter for the innovation led growth?" by matching the models' results.

DOLS results (shown in Table 8) capture the positive effect of FD on lnEG, as the FD coefficient is positive across all of the aforementioned models. Model 1's FD coefficient suggests that a one-unit increase in FD will lead to a 0.2180-unit increase in lnEG. It connotes that FD is advantageous in stimulating the EG of a country, which means the higher the FD, the higher will be the EG. The potential reasoning behind this relation is that FD provides funds for the capital acceleration which in turn promotes investments and endorse savings (An et al., 2021). These savings and investments work as a booster for a nation's EG. Based on this argument, the positive relationship between FD and EG is justified. The results are similar with the other studies (Hassan et al., 2011; Tariq et al., 2020; Wu et al., 2020). Hence, the results support H1. However, Model 2's incorporation of lnIN as a moderator makes the effect of FD on lnEG more pronounced than it was in model 1 (i.e., the coefficient of FD*lnIN is larger in magnitude and significance than the coefficient of FD in model 1). At the 1% level of significance, the result indicates that an increase in FD and lnIN together tends to raise lnEG by 0.1753 units. Findings indicate that there is a positive correlation between increases in lnIN and FD's effect on lnEG, with a 1-unit increase in lnIN increasing the latter by an average of 0.0427 (i.e., 0.2180-0.1753). This substantiates IN's supporting function within the FD-EG nexus. These findings are consistent with our presumptions which are easy to defend. It is understood that FD provides different resources to promote the innovational and R&D activities which leads towards higher productivity (Zhu et al., 2020). However, if these resources are not utilized in a productive way, it becomes difficult to achieve EG (O'Sullivan, 2005), and innovation is mandatory for productivity which justifies the enhancing role of IN. Hence, H5a of the study is also supported.

Table 8: Panel Dynamic OLS (DOLS)

Variables	Model 1 Coefficient (p-value)	Model 2 Coefficient (p-value)	Model 3 Coefficient (p-value)	Model 4 Coefficient (p-value)	Decision
Constant	0.5342^{*} (0.0674)	1.0945^{**} (0.0274)	1.7824^{***} (0.0034)	2.8373^{***} (0.0000)	--
FD	0.2180^{*} (0.0776)	0.0721^{**} (0.0013)	0.2699^{***} (0.0017)	0.1864^{***} (0.0000)	H_1: Supported
FO	0.3447 (0.6985)	0.4162 (0.2345)	0.4094^{***} (0.0045)	0.0104 (0.2395)	H_2: Supported
FDT	0.1481^{**} (0.0371)	0.0493^{***} (0.0067)	0.2053^{**} (0.0203)	0.2017^{**} (0.0424)	H_3: Supported
*ln*IN	0.5249^{***} (0.0002)	0.8316^{***} (0.0035)	0.7481^{***} (0.0000)	0.8902^{***} (0.0029)	H_4: Supported
FD**ln*IN	--	0.1753^{***} (0.0002)	--	--	H_{5a}: Supported
FO**ln*IN	--	--	0.6456^{***} (0.0000)	--	H_{5b}: Supported
FDT**ln*IN	--	--	--	0.3545^{***} (0.0000)	H_{5c}: Supported
Adj. R^2	0.6895	0.7864	0.7953	0.7566	--

Note: ***, **, * represent the level of significance at 1%, 5% and 10%, respectively

The relationship between FO and lnEG is very surprising, as the study does not find any significant association between FO and lnEG. Our results contradict with the previous researchers (i.e., Bekaert et al., 2011; Kim et al., 2012; Juravle et al., 2020), who found that there exist a positive and significant affiliation between FO and EG. However, we can justify our findings with the following argument: as we know that FO refers to the "openness of the financial market of a country to other countries". There is no doubt that this openness increases the inflow of foreign capital in the home country which is beneficial for the EG. But what we will do with that capital when there are no innovational activities in our country? It is understood that innovation is pre-requisite to promote the economic progress (Cederholm & Zhong, 2017). FO can only provide the means to promote these innovational activities but it does not guarantee it. If the government is not issuing the patents to different technological innovations, or not investing the money in R&D activities, then the inflow of foreign money through openness of finance becomes useless. FO will not contribute significantly to the country's EG until or unless it is invested in innovative activities (Bravo-Biosca, 2007). Hence, results do not support H2. However, if we compare the results with model 3, we get exactly what we expected. The significant interaction term of FO*lnIN reinforces our arguments which we have made to justify the insignificant linkage between FO and EG. The coefficient of FO*lnIN is significant at the level of 1% which states that collective increase in FO and lnIN enhances the lnEG by 0.6456 units. Results supported our arguments that alone FO is unable to contribute significantly to the nation's EG; a satisfactory level of innovational activities are required if we want to get significant influence of FO on EG (Zhu et al., 2020). Hence, H5b of the study is accepted.

According to our predictions, the FDT coefficient is positive and statistically significant. Based on the results, we know that a one-unit increase in FDT leads to a 0.1481-unit increase in lnEG. There are strong justifications behind this linkage. First, FDT provides the means of "financial intermediation" which certifies the capital to be distributed in the productive projects that will lead to the higher productivity and hence spurs up the EG (Levine, 2003). Furthermore, FDT endorses the investment in the human and physical capital and promotes industrial activities by providing the sufficient finance. These industrial activities are the boosters of EG, therefore, contributes positively to the nation's EG. Results of the study are highly aligned with the previous researchers (Pradhan et al., 2013; Mukhopadhyay et al., 2011; Jedidia et al., 2014, among others). Hence, H3 is acknowledged. However, the influence of FDT on lnEG become more noticeable when lnIN is incorporated as a moderator. When compared to the coefficient of FDT in model 1, the coefficient of FDT*lnIN is larger and more meaningful. Therefore, at the 1% level of significance, a change of one-unit in FDT and lnIN results in a change of 0.3545 in lnEG. When comparing the effects of FDT on lnEG, a rise of one-unit in lnIN is associated with an increase of 0.2064 (i.e., 0.1481-0.3545) units in lnEG. The results back up the hypothesis that lnIN plays a major moderating role in the connection between FDT and EG. It is argued that IN moderates between FDT and EG, thus allowing one to record the significant effect that FDT has on EG. Hence, H5c of the study is also sustained.

There exists a direct relation between lnIN and lnEG, coefficient of lnIN in Model 1 suggests that an increase of 1 unit in lnIN results in an increase of 0.5249 units in lnEG. The outcomes match our anticipations and the conclusions of prior studies (Verspagen, 2005; Uppenberg, 2009; Li & Solaymani, 2021; Nomaler et al., 2021). IN is elementary component of EG, it is empirically proved that the higher the IN the higher will be the productivity, as IN helps to produce a certain amount of output by using fewer inputs. In addition to this, it transmits the efficiency to the production process and spurs up the nations dynamic growth which is again, having fruitful effects for the country's EG. Hence, H4 is also accepted.

Value of adjusted R^2, reported in model 1, tells us that 68.95% of deviations in lnEG are communally elucidated by FD, FO, FDT and lnIN. When comparing models 1-4 to model 1, however, model 2 through 4 have larger R^2 values, confirming the substantial moderating function of lnIN in the finance-growth nexus.

5. Conclusion and Implications

Finance works as a frontier for the technological convergence and R&D activities which helps expediting the adaptation of new products and services which triggers the gales of innovations and hence leads towards the innovation led growth. This research, thus, examines the moderating role of innovation in the finance-growth nexus with the aim to answer "does finance really matter for innovation led growth of South Asian Region? To achieve this objective, a "balanced panel dataset" has used for four countries of South Asia for 1996-2018. The data for the present study are obtained from WDI. The study considers FD, FDT and FO as predictors. EG and IN are utilized as outcome and moderating variables, respectively. The study applies DOLS to estimate the empirical results.

Findings show significant positive impact of FD and FDT on EG. Whereas, FO shows insignificant impact on EG which becomes significant in the presence of innovation as a moderator. Thus, innovation plays an enhancing role in relation between FD and EG, FDT and EG, and FO and EG. The findings support Schumpeterian model of EG and neo-classical theory.

The results imply that the government of South Asian Economies should improve competition in the "financial markets" through observant privatization and international and national liberalization to heighten the financial markets' depth that resultantly leads towards growing path of EG. Besides, government authorities and specialists of these economies should publicize such policies and rules that encourage the effective independence of central bank of this region, so that it may design functional policies for the development of institutions. Moreover, the findings suggest that the government of South Asian economies should increase its R&D spending and issue more patents to promote the innovational activities which will ultimately lead to the innovation-led growth.

Given the local capabilities and resources, the authors think it may be challenging for this region to attain cutting-edge innovational activities leading to higher growth. Taking advantage of what already exists is often a crucial first step in making a controlled and gradual industrial shift. It is the responsibility of local and regional governments to connect, develop and support a geographic innovation ecosystem that brings together various stakeholders to unlock existing potential and actively stimulates new information and capacities in the region, which ultimately promotes innovation. The study suggests that policymakers who want to strengthen the finance-innovation nexus should set measures against the freeloading of managers of financial companies and establish structures that might allow a meritocratic relationship between financiers and innovators. The study suggested that policymakers enhance their investment in innovation by giving more authority to financial institutions and organizations like private equity and venture capital.

As all, this study also suffers from some limitations that become the future direction for the upcoming researchers. Firstly, this study considers only three measures of finance (such as FO, FD and FDT) to analyze the impact that financial indicators have on the innovation-led growth. For this purpose, the study incorporated innovation as a moderator variable in the study. The studies in future can repeat this research by incorporating other financial indicator (like financial liberalization, financial inclusion, financial literacy etc.). Secondly, cross-country difference exists in the pattern of EG, thus, further studies may repeat this research in other developing and developed countries and compare the findings of these nations to recommend vital implications. The data period can also be enhanced for getting more robust findings. Moreover, different proxies of FDT, FD and FO can also be used to generalize the results. Besides, instead of using conventional methods of analyzing the data, future researchers can use novel methodologies such as fsQCA.

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