Nexus Among Innovations, Financial Development and Economic Growth in Developing Countries

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Abstract:

Studying the level of economic growth remains a topic of discussion among economists and policymakers. As economic growth further impacts the socioeconomic development of the country. The present study has investigated the impact of innovations and financial development on economic growth in case 58 developing counties from 2000 to 2020. To analyze the stationarity of the variables LLC, ADF-Fisher, IPS, and PP-Fisher unit roots have been used.

This study uses a panel autoregressive distribution lag co-integration approach and a vector error-correction model for short-run dynamics of the model. For investigating the causal relationship among the variable's variance decomposition and impulse response function have been applied. The outcomes of the study show that innovations, availability of physical capital, and trade have a positive and significant impact on economic growth. Financial development has significant but inverse influence on economic growth. It is suggested that for higher economic growth, developing countries improve the threshold level of financial development and use an innovative process of production. Urbanization and inflation hurt economic growth. Thus, developing countries should promote a stable inflation rate with liberalized trade, innovation, and physical capital to enhance economic growth.

Keywords: economic growth; financial development; inflation rate; innovations.

JEL Classification: O40; G20; E31; O30.

Introduction

In this globalized era, innovations have become the part and parcel of economic growth (Solow 1956, Romer 1986). Innovations have been considered an inherent tendency for humans to think differently and better as compared to their forefathers. Despite their obvious importance, innovations have not always received the deserved attention from developing countries since the early 2000s (Fagerberg and Srholec 2008).

Although innovations are considered complex and multidimensional processes, researchers highlight their contribution to economic growth, competitiveness, and quality of life. In general, the creation and adoption of new knowledge to improve the value of products, processes, and services. New product development has become the most important factor in this competitive environment (Tidd 2006). Being the driving force of economic growth, innovations have gained much importance in developed countries since the 18th century (Schumpeter 1939). In 1960, some developing countries recognized the role of technological change in the process of economic growth (Solow 1956, Denison 1962), but still, most of the developing countries lag (Audi *et al*. 2021, Audi *et al.* 2022). Presently, the modern economy is often called "the innovative economy" which is emphasizing the role of innovations and modernization of the economy. Several core conditions enable innovations and encourage economic growth, such as innovations are crucial for value creation, growth, and employment, at both regional and national levels. Innovations will also lead to new businesses as well as increase the competitiveness of existing enterprises (Gerguri and Ramadani 2010).

The link between innovations and economic growth has been emphasized in numerous theoretical and empirical studies (Solow 1956, Mansfield 1972, Romer 1986, Raimuni and Nadir 1993). Most of these studies have been conducted in the case of developed economies because developing countries lack data related to innovations and politically manipulated economic growth (Mazzucato 2013). Over the last two decades, new information technology has been responsible for rising economic activities and enhanced productivity (Gerguri and Ramadani 2010, Audi *et al.* 2021). According to (Gurbiel 2002) innovations have the potential to influence the economy, at both macro and micro levels. But still, the number of developing countries does not provide the true picture of the relationship between innovations and economic growth. So, it is fair to say that the question of how technology and innovations influence economic growth is still a controversial issue and needs to be studied (Fagerberg and Srholec 2008).

A financial market is a key factor in deciding the strong process of economic growth because an efficient financial market diver finances and funds from unproductive to productive uses. The role of efficient financial markets may be traced back to the seminal work of Schumpeter (1911). The relationship between financial development and economic growth has been a subject of great interest among economists since the late 1950s (De Gregorio and Guidotti 1995). This discussion has traditionally revolved around two issues: the first relates to whether development in the financial system results in faster economic growth and the second relates to how financial development affects economic growth. The financial system can acquire and process financial information effectively to increase the level of investment and enhances the allocative efficiency of investment as well (Ghirmay 2004).

The relationship between financial development and economic growth has been extensively studied in the previous literature. Now, it is well-recognized that financial development is crucial for economic growth (McKinnon 1992, King and Levine 1993, Neusser and Kugler 1998). Most empirical studies have indicated that well-developed financial markets, enhance the efficiency of resource allocation and faster long-run economic growth via two channels: the capital accumulation channel and the total factor productivity channel. Firstly, being the blood of the economy, it is the quantity of physical capital which decides the speed and level of economic growth. Secondly, efficiency of financial system impact economic growth via easy and fast mobility of savings in capital accumulation. Moreover, efficient financial system work as facilitation center to the economy to generate knowledge spillover from one country to other country, and convergence of some developing countries to developed countries is the best example (Ang 2008). The financial systems of developing countries have led to the common adoption of innovations, as financial innovations with a focus on technology are influencing the supply and demand of money in the economy and affecting economic growth (von Schönfeld and Ferreira 2021, Ali and Rehman 2015, Ali 2015). To study the relationship between financial liberalization and innovation is not an old one (King and Levine 1993). But the relationship between economic growth and financial development has well-established theoretical and empirical roots (von Schönfeld and Ferreira 2021).

Presently, with the fastest process of globalization, the relationship between an advanced financial system, innovations, and economic growth has become one of the most debated issues. The financial system plays an important role in the overall success levels of the economy (Allen *et al.* 2007). The rapidly changing nature of economies with industrialization, this changes even more rapidly with innovations and technology. Today, the financial sector has become the backbone of the dynamics of economic growth. In addition, the increasing integration among countries has led to many socioeconomic, technological, and behavioral changes (O'Rourke and Lollo 2015). Modern economic policies and development strategies have turned into an open economy model. Moreover, with globalization, the concept of the world economy converted into a global village (Ali and Audi 2016, Audi *et al.* 2022).

In the process of economic growth, innovations and financial development are considered the most important indicators (Jedidia *et al.* 2014). The creation and adoption of new knowledge have improved the value of products, processes, and services (Tidd 2006). This study has empirically investigated the link between innovations, financial development, and economic growth in the case of developing countries. Previous studies have linked financial development and economic growth but innovations have been ignored (Posner 1961, Bell and Pavitt 1993, Schumpeter 1939, Kahneman and Tversky 2013). Moreover, previously, credit to the private sector has been considered a measure of financial development, this study has constructed an index of financial development with the help of money supply, interest rate, and credit to the private sector. Previous studies have used R&D expenditures as a measure of innovations (Rogers and Rogers 1998), this study has constructed an index with the help of R&D expenditures, education level, and use of computers. These indices are hardly available in the existing literature. This research is useful to explain and understand how innovations and financial development affect economic growth in the case of developing countries. So, this study is a healthy contribution to the respective literature.

1. Literature Review

The part of the study is comprised of the literature review and here most recent and relevant studies have been selected for this purpose. Following existing literature, we know that, in the process of economic growth, innovations are considered the most important indicators (Cavdar and Aydin 2015). The creation and adoption of new knowledge have improved the value of products, processes, and services, as product development has become the most important factor in the competitive environment (Tidd, 2006). The contribution of technological innovations to national economic growth has been emphasized in numerous theoretical and empirical studies (Solow 1956, Romer 1986). The relationship between innovations, entrepreneurship, and economic growth has been the mainstream discussion among many empirical studies (Porter 1990, Baumol 1993, Lumpkin and Dess 1996). Audi and Ali (2021) investigate the impact of advancement in information and communication technologies (ICT) on economic development. The results of this study show that advancement in information and communication technologies has an insignificant relationship with economic development and plays a positive and significant role in economic development in the case of developing countries. The findings of this study strongly show that developing countries should introduce new and advanced information and communication technologies (ICT) for competing with developed countries in the process of economic development.

Many studies have found links between financial development and economic growth (Schumpeter 1939, Posne 1961, Kahneman and Tversky 2013, Bell and Pavitt 1993). Financial development constitutes the promotion of financial products and services, the development of new financial processes as well as the interaction with customers, and the development of new structures for financial institutions (Mention 2011). Innovations continue to play a key role in economic growth and reduce the gap of competitiveness and uneven knowledge gap between developed and developing countries (Salas-Guerra and Cesar 2021).

Jung (1986) investigates international evidence on the causal relationship between financial development and economic growth. The results of this study show that the monetization variable exhibits the reverse causal pattern among LDCs and provides moderate support for the Patrick hypothesis. There is another study, (Levine *et al.* 2000) that link financial development to economic growth. The findings show a strong positive relationship between financial development and output growth. But finance development partly explains economic growth. Thus, there is existence of growth-enhancing hypothesis through financial development. Halifa Al-Yousif (2002) empirically examines the relationship between financial development and economic growth. The empirical results of this study toughly support the opinion that financial development and economic growth are equally causal. The outcomes of the empirical analysis show that bidirectional causality is running between economic growth and financial development. Ali and Rehman (2015) empirically examine the impact of macroeconomic instability detrimental to the gross domestic product in the case of Pakistan. The results of the study also show that macroeconomic instability has a deep-rooted and detrimental impact on the gross domestic product of Pakistan. The findings of this study are that government should make appropriate policies for raising the pace of economic growth in Pakistan.

2. Background to Empirical Model

This section is comprised of the theoretical background to the empirical model of our article. The main purpose of theory is to construct models that define the behavior of an individual and society as a whole. Normally, a model represents real situations of different units in the presence of some assumptions and abstractions. These abstractions depend on the purpose for which the model has been constructed. The basic objective behind the construction of the model is to analyze and predict. The predicting power, provided information, realism, and simplicity of assumptions and generality would decide the validity of the model (Nagel 1963).

Theoretically, the link between innovations, knowledge and economic growth is established by (Marshall 1890, Solow 1956) later it is augmented and strengthened by (Kuznets 1971, Mansfield 1972, Romar 1986, Nadiri 1993). These studies have been recognizing the direct and indirect impact of knowledge on economic activities. Moreover, from a broader perspective, innovations attempt to improve products, processes, or ways to think people about economic activities (Schumpeter 1939, Bell and Pavitt 1993). Many studies have described how innovations and entrepreneurship affect the economy (Porter 1990, Baumol 1993, Lumpkin and Dess 1996).

The new growth model begins with (Solow 1980), this model has three basic components for measuring economic growth, *i.e.,* labor (L) capital (K), and technology (A).

$$Y=AK^{\alpha} L^{(1-\alpha)} \tag{1}$$

where: Y = Economic growth.

Romer (1986) and Lucas (1988) extended the Solow model by including human capital; as they believe that human capital can lead to captivate technology and stimulate economic growth. The form of the economic growth model become as:

$$Y=K^{\alpha} (AH)^{1-\alpha} \tag{2}$$

where: H = Human capital.

Since the endogenous growth model allows us to include some additional variables for the determination of economic growth. The studies, *e.g.,* (Anaman 2004, Kogid *et al.* 2010) incorporate government expenditure, exchange rate, inflation, labor, consumption expenditure, foreign aid, corruption, financial development, education, population growth, and life expectancy as determinants of economic growth. Since, the total productivity factor has an indirect relationship with total output, which depends on technology and efficiency. This means that the total productivity factor productivity impacts economic growth via the transfer of technology (Takumah and Iyke 2017). This study is examining the impact of innovations and financial development on economic growth in the case of selected developing countries. Following the basic Cobb-Douglas production function, and empirically tested by (Pendharkar *et al*. 2008, Miller 2008, Ali and Rehman 2015, Ali 2015), the model of this study can be formulated as follows:

$$ECOG_{it} = F(FIN_{it}, CAPITAL_{it}, INN_{it}, TRADE_{it}, URB_{it}, INF_{it}) \tag{3}$$

where: ECOG = Economic growth (measured with the help of GDP growth rate); FIN = Financial development (an index has been constructed with the help of money supply, interest rate, credit to the private sector, etc.); CAPITAL= Available physical capital (measured with the help of capital formation); INN = Innovations (an index has been constructed with the help of R&D expenditures, level of education, use of the computer, etc.); TRADE = Merchandised trade (measured with the help of merchandised trade among countries); URB = Urbanization (measured with the help of urban population); INF = Inflation rate (GDP deflator has been used as inflation rate); *i* = the country (58 developing countries have been selected for this empirical analysis); *t* = time period (data from 2000 to 2020 has been selected)

For checking the responsiveness of the dependent variable for the independent variables, the equation can be written as:

$$ECOG_{it} = AFIN^{\beta 1}_{it}\, CAPITAL^{\beta 2}_{it}\, INN^{\beta 3}_{it}\, TRADE^{\beta 4}_{it}\, URB^{\beta 5}_{it}\, INF^{\beta 6}_{it}\, U_{it} \tag{4}$$

The econometric model of the study becomes as:

$$ECOG_{it} = A+\beta_1 FIN_{it}+\beta_2 CAPITAL_{it}+\beta_3 INN_{it}+\beta_4 TRADE_{it}+\beta_5 URB_{it}+\beta_6 INF_{it}+U_{it} \tag{5}$$

All the variables explained above except *A* and *U*.
where: A = constant intercept; *U* = error term (supposed to be white noise).

Data of selected variables have been taken from World Development Indicators (WDI), online databases maintained by the World Bank.

3. Econometric Methodology

The application of econometric tools to macroeconomic models is one of the most important aspects of quantitative economic analysis. This section is comprised of econometric methodologies which are used for empirical analysis.

3.1. Panel Unit Root

The study uses the unit root tests to check the stationary of the panel. Panel data unit root tests have been used following the recent literature to adjust the difference in mean and variance within a variable. Various tests can be used to identify a unit root problem in panel data, namely those of (Maddala and Wu -MW 1999, Im, Pesaran and Shin –IPS 2003, Levin, Lin and Chu –LLC 2002, Hadri's 2000). For checking the stationarity of the panel data Levin, Lin and Chu t*, ADF - Fisher Chi-square, Im, Pesaran, and Shin W-stat, and PP Fisher Chi-square unit root tests have been used. The methodology follows as:

$$\Delta y_{i,t} = \gamma_{0i} + py_{it-1+}\sum_{i-1}^{pi}\gamma_{1i}\Delta y_{i,t-j} + u_{i,t} \tag{6}$$

where: " γ_{0i} is the constant parameter in the equation (6), this has exceptional properties for the cross-sectional units and p is the same for all the coefficients of autoregressive; γ_i presents the selected order of lags for the model; $u_{i,t}$ is the disturbance term, it is normally considered to be autonomous for all of the selected across of panel units.

This equation (6) is based on the Autoregressive Moving Average (ARMA) stationary procedure for respective cross-sections, then eq. can be presented as:

$$u_{i,t} = \sum_{j-0}^{\infty} \gamma_{1i} \Delta y_{i,t-j} + \varepsilon_{i,t} \tag{7}$$

Based on equation (7), following hypotheses has been tested:

H_0: $p_i = p = 0$.

H_a: $p_i = p < 0$ for all *i.*

The t-test can be utilized for the LLC model, where *p* is supposed to be fixed for the across and units, by following, the null and alternative hypothesis.

$$t_p = \frac{\hat{p}}{SE(\hat{p})} \tag{8}$$

Throughout this process, it has been assumed that the error series is following all properties of white-noise error. Moreover, the panel *eq*. for regression has t_p test statistics, it shows the convergence of all selected standard normally distributed series, for example, N and $T \to \infty$ $\sqrt{\frac{N}{T}} \to 0$. On the opposite sideways, if some units of the section are not independent of each other, then the residual of the selected series would be corrected, as this raises the chances of auto-correlation. Because of such conditions LLC test assumes an alternative test statistic:

$$t_p = \frac{t_p - N\tilde{T}\hat{S}_N \hat{\sigma}^{-2}(\hat{p})\mathrm{u}_m^*}{\sigma_m^*} \tag{9}$$

where: u_m^* and σ_m^* are supposed to be augmented by the residual series, and its standard deviation.

The coefficients of these estimates can be calculated with the support of Monte Carlo Simulation, our unit test LLC (2002) also followed this value.

Im *et al*. (2003) introduced another panel stationary test, under such conditions when the panel data have heterogeneity. This method has followed the procedures of ADF unit root, but this method had used a modest mean of all series, the main equation. of this test can be written as:

$$\Delta y_{i,t} = \bar{w}_i + p y_{it-1+} \sum_{i-1}^{pi} \gamma_{1i} \Delta y_{i,t-j} + v_{i,t} \tag{10}$$

The IPS test permits the unit root process when we have heterogeneity in v_i values, then the IPS unit root test eq. would be written as:

$$\bar{t}_T = \frac{1}{N} \sum_{i-1}^{N} t_{1,i}(\mathrm{p}_i) \tag{11}$$

where: $t_{i,t}$ is the test statistic for ADF, lag order can be presented by p_i.

The main procedures for the analysis would be followed as:

$$A_{\bar{t}} = \frac{\sqrt{N(T)}[\bar{t}_T - \mathrm{E}(t_T)]}{\sqrt{Var(t_T)}} \tag{12}$$

3.2. Panel Co-Integration

After checking the stationary of data and confirming that each series is integrated in the same order, the next step is to check whether these series can be combined into a single series, which itself must be non-stationary, which is known as co-integration. Co-integrated series move in the same direction in the long run and are in equilibrium relationship-integration tests have been developed by (Granger 1981) and extended by (Engle and Granger 1987).

To overcome the problem, scholars introduce panel co-integration, which pools both time series and cross-sectional data to analyze the relationship between the non-stationary variables I (1). This study employed the (Padroni 1999) panel co-integration test. This test is the extension of (Engle-Granger 1987) in the context of panel data. Padroni introduced seven co-integration tests which are categorized into two dimensions which are: within dimension-based statistics, referred to as co-integration statistics containing four test panels: v-statistics, panel p statistics, panel t- statistics (non -parametric), and panel t-statistics (parametric). The other is between- dimension based statistics, which are referred to as group mean panel co-integration statistics. The tests are divided into three: group p- statistics, group t-statistics (non -parametric), and group t-statistics (parametric). The test is defined as follows:

- Panel *v* statistic:

$$Z_v = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{\ell}_{i,t-1}^{2} \right)^{-1} \tag{13}$$

- The panel *t* statistic:

$$Z_p = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{\ell}_{i,t-1}^{2} \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{\ell}_{i,t-1} \Delta \hat{\ell}_{i,t} - \hat{\lambda}_i \right) \tag{14}$$

- The panel *t* statistic (non-parametric):

$$Z_i \equiv \left(\overset{2}{\tilde{\sigma}}_{N,T} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{\ell}_{i,t-1}^{2} \right)^{-1\backslash 2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{\ell}_{i,t-1} \Delta \hat{\ell}_{i,t} - \hat{\lambda}_i \right) \tag{15}$$

- The panel *t* statistic (parametric):

$$\overset{*}{Z}_t \equiv \left(\tilde{S}_{N,T}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{\ell}_{i,t-1}^{*2} \right)^{-1\backslash 2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{\ell}_{i,t-1}^{*} \Delta \hat{\ell}_{i,t}^{*} \right) \tag{16}$$

- The group *t* statistic (parametric):

$$\tilde{Z}_P \equiv TN^{-1\backslash 2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{\ell}_{i,t-1}^{2} \right)^{-1} \sum_{t=1}^{T} \left(\hat{\ell}_{i,t-1} \Delta \hat{\ell}_{i,t} - \hat{\lambda}_i \right) \tag{17}$$

- The group *t* statistic (non-parametric):

$$\tilde{Z}_t \equiv N^{-1\backslash 2} \sum_{i=1}^{N} \left(\hat{\sigma}_i^{2} \sum_{t=1}^{T} \hat{\ell}^{2}_{i,t-1} \right)^{-1\backslash 2} \sum_{t=1}^{T} \left(\hat{\ell}_{i,t-1} \Delta \hat{\ell}_{i,t} - \hat{\lambda}_i \right) \tag{18}$$

- The group t statistic (parametric):

$$\tilde{Z}^{*}_t \equiv N^{-1\backslash 2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{S}^{*2}_i \hat{\ell}^{*2}_{i,t-1} \right)^{-1\backslash 2} \sum_{t=1}^{T} \left(\hat{\ell}^{*}_{i,t-1} \Delta \hat{\ell}^{*}_{i,t} \right) \tag{19}$$

where: λ ^i is a consistent estimator of the long-run variance.

$$\hat{L}^{2}_{11} = \frac{1}{T} \sum_{t-1}^{T} \hat{\eta}^{2}_{i,t} + \frac{2}{T} \sum_{s=1}^{ki} \left(1 - \frac{S}{K_1 + 1} \right) \sum \hat{\eta}_{i,t} \hat{\eta}_{i,t-s,} \ \sigma_i^{\wedge 2} = S_i + 2\hat{\lambda}_i, \hat{S}_i = \frac{1}{T} \sum_{t=1}^{T} \eta_{it,}$$

$$\sigma^{2}_{N,T} = \frac{1}{N} \sum_{t=1}^{N} \hat{L}_{11} \hat{\sigma}^{2}_i \hat{S}^{*2}_i = \frac{1}{t} \sum_{t=1}^{T} \hat{\eta}^{-2}_{i,t} \tilde{S}^{*2} \tag{20}$$

And the residuals η^ I, t, and η^* I, t and η^ I, t are obtained from the following regression:

$$\hat{\ell}_{i,t} = \hat{\gamma}_i \hat{\ell}_{i,t-1} + \eta_{i,t}, \hat{\ell}^{*}_{i,t} \hat{\gamma}_i \hat{\ell}_{i,t-1} + \sum_{k=1}^{ki} \hat{\gamma}_{i,k} \Delta \hat{\ell}_{i,t-k} + \hat{\eta}^{*}_{i,t}, \gamma_{i,t} = \sum_{M-1}^{N} \hat{b}_{mi} \square x_{mi,t} + \hat{\eta}_{i,t} \tag{21}$$

Therefore, the null hypothesis of no co-integration is said to take place when residuals are non-stationary. On the other hand, when the residuals are stationary, there is co-integration. Given there is panel co-integration between the results, the long-run relationship can further be estimated using panel co-integration estimation namely Ordinary Least Square and Fully modified OLS (FMOLS) estimator. It was developed by Phillips, Moon and Padroni in 1999, 1995, 2000 respectively, and Dynamic OLS (DOLS) was developed by Kao and Chiang in 2000. Unfortunately, (Kao *et al.* 1999) found that the OLS estimator is biased in analyzing non-stationary data. Fully modified OLS was then developed to correct the serial correlation and endogeneity of the OLS estimator. The test was developed by Philips and Hansen (1990), and extended to the context of heterogeneous panels by Pedroni (1999).

3.3 Variance Decomposition

In applied econometrics number of causality tests are available, but among them, Vector Error Correction Method (VECM) is used in most cases. The drawback of this test is that it only finds the causal relationship of variables within the sample period and does not give information about the future relationship.

Moreover, VECM is unable to detect the feedback impact of one variable on other variables. For finding the exact feedback points and the impact of shocks of one variable on other variables, variance decomposition, and impulse response functions are used. Variance decomposition finds the magnitude of shocks of one variable to other variables within the selected period and beyond the selected time zone. Whereas the impulse response gives us details about the feedback impact of one variable on another variable within and beyond the selected period.

Variance decompositions are a slightly different approach for exploring the SVAR system dynamics. The variance decomposition approach explains how many unanticipated changes are explained by different shocks. Variance decompositions indicate the percentage of the forecast error variance in one variable that is due to errors in forecasting itself and each of the other variables (Alami, 2001). From the variance decompositions, it is possible to learn if the corresponding effects of one variable upon another are important in a relative sense. Of particular concern in this study is the percentage variation in the social progress explained by macroeconomic instability with some control variables. Silvey (1969) presented the method of variance decomposition he decomposes a coefficient variance into a sum of terms each of which is associated with a singular value and (Belsely *et al.* 1980) extended his work. For reviewing the OLS under the model:

$$E_m(\mathrm{X}) = Y\beta \tag{22}$$

And $Var_m(X) = \sigma^2 I_n$

where: I_n is the $n \times n$ identity matrix.

$\hat{\beta} = (Y^t Y)^{-1} Y^t X$ and its $Var_m(\beta) = \hat{\sigma^2}(Y^t Y)^{-1}$

Using the singular-value decomposition $Y = UDV^t$ and the $\mathrm{Var}_m(\hat{\beta})$ can be written as:

$$\mathrm{Var}_m(\hat{\beta}) = \sigma^2[(UDV^t)^t (UDV^t)]^{-1} = \sigma^2 VD^{-2}V^t \tag{23}$$

And the k^{th} diagonal element $\mathrm{Var}_m(\hat{\beta})$ is the estimated variance for the k^{th} coefficient $\hat{\beta}_k$. So, using the equation (23) $\mathrm{Var}_m(\hat{\beta}_k)$ can be expressed as:

$$\mathrm{Var}_m(\hat{\beta}_k) = \sigma^2 \sum_{j=1}^{p} \frac{v_{kj}^2}{\mu_j^2} \tag{24}$$

where: $V = (\mathrm{V}_{kj})_{p \times p}$

Let $\phi_{kj} = v_{kj}^2 / \mu_j^2, \phi_k = \sum_{j=1}^{p} \phi_{kj}$ and $Q = (\phi_{kj})_{p \times p} = (VD^{-1}).(VD^{-1})$

The variance decomposition proportions are $\pi_{jk} = \phi_{kj} / \phi_k$ which is the proportion of the variance of the k^{th} regression coefficient associated with the j^{th} component of its decomposition in equation (24). Denote the variance decomposition proportion matrix as

$$\prod = (\pi_{jk})_{p \times p} = Q^t \bar{Q}^{-1} \tag{25}$$

where: $\bar{Q}$ is the diagonal matrix with the row sum of Q on the main diagonal and 0 elsewhere,

Since at least one v_{kj} must be non-zero in equation (24), this implies that a high proportion of any variance can be associated with a large singular value even when there is no co-linearity. The standard approach is to check a high condition index associated with a large proportion of the variance of two or more coefficients when diagnosing co-linearity since there must be two or more columns of Y involved to make a near dependency.

3.4. Impulse Response Function

The impulse response function has a special interpretation in applied macroeconomic modelling because it describes the reaction of an economy in response to different shocks over time. The impulse response function helps us to trace out the time path of the impacts of shock on variables in the VAR. These shocks can be modelled with the help of a standard Vector Autoregressive (VAR) process and impulse response analysis follows the nonlinear methodology.

Hamilton (1994) mentions that the impulse response function is used for examining the reaction of endogenous macroeconomic variables at the time of the shocks and over the subsequent points in time. Mörling (2002) explains that impulse response analysis illustrates the response of a system to one-standard deviation shocks to one of the variables. This method is best for finding the causal relationship between variables as compared to the Granger Causality test (Lin and Bever 2006). Impulse response analysis can also separate the impact of positive impulses from negative impulses (Lanne and Lutkepohl 2008, Hatemi-J 2014). This method is best for estimating the overall interdependence among the variables of the models.

Let X_t be a k-dimensional vector series that is generated by following the autoregressive process:

$$X_t = a_1 X_{t-1} + ... + a_p X_{t-p} + \varepsilon_t \tag{26}$$

$$X_t = \phi(b)\varepsilon_t = \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i} \tag{27}$$

$$I = (\mathrm{I} - a_1 b - a_2\, \mathrm{b} - .... - a_p b^p)\phi(\mathrm{b}) \tag{28}$$

Here $\mathrm{cov}(\varepsilon_t) = \sum, \phi_i$ are the MA coefficients which measure the impulse response. Generally, $\phi_{jk,i}$ explains the response of variable *j* to a unit impulse in variable *k* occurring in the *i-th* period ago. By using these coefficients impulse response analysis can evaluate the effectiveness of policy change.

Usually, $\sum$ is non-diagonal and it explains how a dependent variable is fixed by the possible shocks of the independent variable. For its better understanding, a simple transformation is required. The most famous transformation used in literature is Cholesky decomposition. Let P is a lower triangular matrix such as $\sum = PP^{/}$. Then the equation (28) can be written as:

$$X_t = \sum_{i=0}^{\infty} \theta_i \omega_{t-i} \tag{29}$$

where: $\theta_i = \phi_i P, \omega_t = P^{-1}\varepsilon_t$ and $E(\omega_t, \omega_t^{/}) = \mathrm{I}$.

Let *D* be a diagonal matrix with the same diagonals as *P* and $W = PD^{-1}, \Lambda = DD^{/}$ after some manipulation we get:

$$X_t = b_0 X_t + b_1 X_{t-1} + ... + b_p X_{t-p} + \mu_t \tag{30}$$

where: $b_0 = I_k - W^{-1}, W = PD^{-1}, b_i = W^{-1} a_i$.

Here b_0 it represents the lower triangular matrix with *0* diagonals. Simply now we conclude that Cholesky decomposition shows the causal reaction between the variables of the model. For getting the required results the following two conditions are necessary.

For a *k* –dimensional stationary VAR (p) process: $\phi_{j,k,i} = 0$ And for $j \neq k, \mathrm{i} = 1, 2, 3, 4, ...$ it is equal to $\phi_{j,k,i} = 0$ And for $i = 1, 2, ..., p(k-1)$. It means that if the first $\phi_{j,k,i} = 0$ and for $pk - p$ response to variable *j* to an impulse in variable *k* is zero, then all the following responses are zero. Variable *k* does not cause variable *j* if and only if $\phi_{j,k,i} = 0$ and for $\mathrm{i} = 1, 2, 3, 4, ...$.

4. Estimated Results and Discussions

This article has conducted a nexus among innovations, financial development, and economic growth in the case of developing countries from 2000 to 2020. This section presents the empirical results and discussion on estimated results and tries to answer our basic question that how financial development, innovations, and economic growth are interlinked with each other.

The estimated long-run and short-run results of the study have been presented in Table 1. The level of economic growth of an economy requires a strong financial sector. Strong financial sector provides roots to higher economic growth via financial institutions, markets and sustainable investments (Levine 1996, Demirguc-Kunt 2008). Optimum and better utilization of available resources and higher profitable investment can be possible with sound financial development (Greenwood and Jovanovic 1990, Ehigiamusoe and Samsurijan 2021). These are the strong financial institutions which reduce the national and international transaction costs with effective implementation of financial legislations (Kidwell *et al.* 2016). With the passage of time, the structural and innovative changes in the financial system tie the individuals and firms together for the welfare of the economy as whole (Guru and Yadav 2019). Without the help of financial system, the individual savings cannot be converted into profitable investments (Stiglitz and Weiss 1983, Diamond 1984), and there is less information cost thus better resource allocation can be attained (Greenwood and Jovanovic 1990). Moreover, the developed financial system is attached with less corporate governance cost too (Bencivenga and Smith 1993, Levine 1997) also highlights the importance of financial systems in national and international trade. It is the financial system which work as bridge between real sector and financial sector (Das and Guha-Khasnobis 2008). In the case of developing countries, there may be an inverse relationship between financial development and economic growth, as according to Lucas (1988), financial markets play less role in the process of economic growth. Our estimated results show that in long run, financial development significantly and inversely influence the economic growth. But in short run this relationship becomes insignificant. Shan (2005) mentions that the financial markets of developing countries, especially, Asian countries are unable to allocate a large inflow of funds into profitable ventures. Guru and Yadav (2018) also find the same type of relationship between financial development and economic growth in the case of BRICS.

Table 1. Long and Short Run coefficients

Dependent variable: Economic Growth: ARDL(1,0,1,1,0,1)				
Variable	Long Run Outcomes		Short Run Outcomes	
	Coefficient	Std. Error	Coefficient	Std. Error
FIN	-0.044858***	0.007589	0.074825	0.048951
CAPITAL	0.027571*	0.018648	0.435960***	0.090016
INN	0.037903**	0.015657	-0.007264	0.081786
TRADE	0.028474***	0.006611	0.092058***	0.030754
LURB	-0.315087	0.480339	-100.495300*	65.196270
INF	-0.048575***	0.017017	0.095795***	0.032891
ECT	-	-	-0.905800***	0.045307

Note: 1%, 5% and 10% levels presented by ***, ** and *, respectively.

The availability of physical capital refers to as income or output-producing capacity of a country (Islam and Alam 2019). These are gross savings out of income that make a possible portion of gross investment portion out of national income. Gross investment offsets capital consumption and adds to productive capacity for future periods. Neoclassical growth theory and endogenous growth theories starightwardly mention that the accumulation of physical capital and human capital play important role in determining economic growth (Solow 1956, Romer 1986, Lucas 1988). Our estimated long-run and short-run results show that the availability of physical capital has a positive and significant impact on economic growth in the case of developing countries. These findings are consistent with the finding of (Easterly and Levine 1997, Chen and Feng 2000, Bleaney *et al.* 2001, Freire-Seren 2002, Anaman 2004, Acikgoz and Mert 2005, Bayraktar 2006, Asheghian 2009, Checherita-Westphal and Rother 2012, Ali 2015, Ali and Rehman 2015, Fetahi-Vehapi *et al.* 2015, Ali and Audi 2018).

Innovations are one of the driving forces of economic growth (Solow 1956, Mansfield 1972, Romar 1986, Nadiri 1993, Cameron 1996, Andergassen *et al.* 2009, Santacreu 2015, Bae and Yoo 2015), and these have become a pervasive indicator of our lives and lifestyle as well. In the last few years, economists and policymakers have paid much attention to examine the link between innovations and regional economic output (Howells 2005, Wang *et al.* 2009, Malerba and Brusoni 2007, Grossman *et al.* 2017, Galindo and Mendez-Picazo 2014, Tsvetkova 2015). Unlike natural resources, innovations are man-made resources with continuously increasing abundance (Starr and Rudman 1973). Innovations can impact an economy in multiple ways, *i.e.,* employment, trade openness, quality of life, financial systems, global competitiveness, economic growth, and infrastructure development, and hence, spawns' high economic growth. Our long-run results show that innovations have a positive and significant impact on economic growth in the case of developing countries. Lichtenberg (1992) highlights the positive impact of innovations on productivity and growth, our long-run findings are consistent with these studies. But in the short-run innovations have a negative and insignificant impact on economic growth in developing countries. These findings show that the relationship between innovations and economic growth is a long-run phenomenon rather than a short-run (Silverberg and Verspagen 1994, Wang 2013).

Historically, the relationship between trade and economic growth remains controversial (Grossman and Helpman 1991, Rivera-Batiz and Romer 1991, Barro and Sala-i-Martin 1992, Edwards 1998). Some researchers recommend that lowering trade restrictions raises the level of international trade through the reduction of transaction costs which further raises the level of economic growth. Likewise, it can be argued that developing countries that have opened their economy to the rest of the world have a greater ability to absorb the advanced technologies of the developed countries. Whereas, some economists argue that some forms of protection are necessary for the survival of the country, *i.e.*, infant industry and local employment burden, etc., which are responsible for the economic growth of the country. Rodríguez and Rodrik (2000) mention that the positive and negative effects of trade are related as a matter of course but pose conceptually distinct questions and different qualitative and quantitative outcomes. Trade policies can be seen as responses to market imperfections or as a mechanism of rent-seeking. Thus, rising trade is attached to the higher economic growth of the nation. Our estimated results show that trade has a positive and significant impact on economic growth in the long run and short run. These findings are consistent with (Ben-David 1993, Sachs and Warner 1995, Edwards 1998, Warner 2003, Dollar and Kraay 2004, Barro and Sala-i-Martin 2004, Noguer & Siscart 2005, Manole and Spatareanu 2010, Squalli & Wilson 2011).

21st century is attached to rising urbanization throughout the world, although, this urbanization varies across regions and countries. In the last few years, the relationship between rising urbanization and economic growth has got much importance among policymakers and economists. The link between urbanization and economic growth is often portrayed as inevitable and automatic, like some sort of universal law governing an immutable historical process. Some studies find a positive relationship between urbanization and economic growth (Ali and Rehma, 2015, Ali 2015, Nguyen 2018), but some studies find an inverse relationship between urbanization and economic growth (Nathaniel 2020). Our results show that urbanization has a negative and insignificant impact on economic growth in the long run, but in the short run, urbanization has a negative but significant impact on economic growth. There numerous studies (Henderson 2003, Al-Mulali *et al.* 2015) mention that urbanization has an insignificant impact on economic growth in the case of developing countries.

The relationship between inflation and economic growth is of great interest in macroeconomics and monetary policy modeling (Batini and Nelson 2001). Although the relationship between the inflation rate and economic growth has been studied extensively, nevertheless the exact relationship is not well defined (Friedman 1956, Wai 1959, Dorrance 1966, Sidrauski 1967, Stockman 1981, Barro 1995, Bruno and Easterly 1998). Our results show that inflation has a negative and significant impact on economic growth in the long run. These findings are consistent with (Risso and Carrera 2009, Kasidi and Mwakanemela 2013, Majumder 2016). But in the short run inflation has a positive and significant impact on economic growth in developing countries.

The value of ECT is theoretically correct, with a negative and significant value. This reveals that short deviations in the economic growth of developing countries need one year, and one month to converge in the long run. This also shows that 90% of short-run deviations in economic growth are corrected very next year in the case of developing countries.

The results of variance decomposition have been given in Table 2. The results reveal that 95.59% as a part of economic growth is explained by its own created shocks. Whereas shocks of financial development contribute to Economic growth by 0.63%. The results show that the availability of physical capital, innovations, trade, urbanization, and inflation contribute to economic growth by 1.20%, 2.29%, 0.088495%, 0.08%, and 0.10%, respectively. The results show that 11.10% of shocks in financial development are due to economic growth, whereas 87.13% of shocks in financial development is explained by their own created shocks. The results show that the availability of physical capital, innovations, trade, urbanization, and inflation contribute to shocks of financial development by 0.63%, 0.32%, 0.61%, 0.05%, and 0.12%, respectively. The results show that 15.68% of shocks in the availability of physical capital are due to economic growth, whereas 82.85% of shocks in the availability of physical capital are explained by their own created shocks. The results show that financial development, innovations, trade, urbanization, and inflation contribute to shocks of availability of physical capital by 0.73%, 0.21%, 0.33%, 0.15%, and 0.01%, respectively. The results show that 0.30% of shocks in innovations are due to economic growth, whereas 98.78% of shocks in innovations are explained by their own created shocks. The results show that the availability of physical capital, financial development, trade, urbanization, and inflation contribute to shocks of availability of physical capital by 0.14%, 0.63%, 0.12%, 0.007%, and 0.007%, respectively. The results show that 2.47% of shocks in trade are due to economic growth, whereas 92.83% of shocks in trade are explained by their own created shocks. The results show that the availability of physical capital, financial development, innovations, urbanization, and inflation contribute to shocks of trade by 0.86%, 0.73%, 0.42%, 0.04%, and 2.62%, respectively. The results show that 2.47% of shocks in urbanization are due to economic growth, whereas 96.31% of shocks in urbanization are explained by their own created shocks. The results show that the availability of physical capital, financial development, innovations, trade, and inflation contribute to shocks of urbanization by 0.03%, 0.48%, 0.006%, 1.40%, and 0.16%, respectively. The results show that 2.47% of shocks in inflation are due to economic growth, whereas 85.34% of shocks in inflation are explained by their own created shocks.

Table 2. Variance decomposition

Variance Decomposition of ECOG								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	3.156189	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	3.420741	98.08206	0.066116	0.007026	1.725905	0.005019	0.002485	0.111386
3	3.516303	97.71412	0.194575	0.051997	1.898586	0.024458	0.007685	0.108581
4	3.554006	97.32978	0.269349	0.194740	2.043796	0.038330	0.015090	0.108913
5	3.571774	96.96301	0.335352	0.398038	2.121627	0.049448	0.024320	0.108205
6	3.582722	96.61827	0.394904	0.612945	2.172402	0.058938	0.034945	0.107600
7	3.590563	96.30746	0.452673	0.808257	2.210472	0.067325	0.046684	0.107132
8	3.596684	96.03443	0.510685	0.972263	2.241569	0.074957	0.059324	0.106771
9	3.601685	95.79649	0.569820	1.103915	2.268605	0.081988	0.072698	0.106487
10	3.605895	95.58844	0.630403	1.206825	2.292909	0.088495	0.086672	0.106260
Variance Decomposition of FIN								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	4.105278	0.000502	99.99950	0.000000	0.000000	0.000000	0.000000	0.000000
2	6.447890	0.892824	98.06526	0.113957	0.423045	0.469410	0.002790	0.032719
3	8.270313	2.648661	95.84954	0.222054	0.519091	0.700837	0.007461	0.052358
4	9.791639	4.562815	93.78387	0.293784	0.508880	0.770514	0.013106	0.067028
5	11.11185	6.265929	92.03934	0.348256	0.472815	0.775149	0.019364	0.079143
6	12.28413	7.672178	90.62306	0.399806	0.435412	0.753953	0.026080	0.089512
7	13.34149	8.809271	89.47995	0.454199	0.402308	0.722500	0.033176	0.098598
8	14.30621	9.729082	88.54957	0.512618	0.374007	0.687366	0.040603	0.106758
9	15.19424	10.48004	87.78167	0.574324	0.349846	0.651543	0.048323	0.114253
10	16.01743	11.10069	87.13826	0.637974	0.329028	0.616481	0.056305	0.121266
Variance Decomposition of CAPITAL								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	2.339974	5.612682	1.673061	92.71426	0.000000	0.000000	0.000000	0.000000
2	3.512021	8.366232	1.267673	90.30878	4.33E-06	0.029019	0.002100	0.026192
3	4.278384	10.62073	1.108342	88.16015	0.015624	0.066942	0.007528	0.020679
4	4.800769	12.23119	1.003520	86.58656	0.042294	0.103150	0.016847	0.016433
5	5.171094	13.38305	0.926650	85.43321	0.072356	0.139770	0.030263	0.014703
6	5.440548	14.19978	0.867458	84.59001	0.102992	0.177483	0.047779	0.014501
7	5.640187	14.77809	0.820889	83.96739	0.132875	0.216494	0.069240	0.015026
8	5.790030	15.18776	0.784113	83.49967	0.161589	0.256643	0.094385	0.015839
9	5.903610	15.47780	0.755414	83.14054	0.189031	0.297608	0.122879	0.016728
10	5.990399	15.68243	0.733691	82.85774	0.215206	0.339004	0.154340	0.017594
Variance Decomposition of INN								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	2.828994	0.076566	0.341047	0.007304	99.57508	0.000000	0.000000	0.000000
2	3.772334	0.059044	0.243686	0.017311	99.51955	0.159146	0.000184	0.001082
3	4.482182	0.084703	0.242300	0.023831	99.45777	0.189743	0.000697	0.000951
4	5.057592	0.098852	0.265966	0.031881	99.41039	0.189186	0.001397	0.002329
5	5.536654	0.123272	0.304028	0.043809	99.34366	0.179361	0.002232	0.003641
6	5.947189	0.152771	0.353865	0.059058	99.25970	0.166587	0.003155	0.004863
7	6.304543	0.186144	0.412997	0.077053	99.16024	0.153613	0.004130	0.005823
8	6.619398	0.222821	0.480311	0.097231	99.04638	0.141583	0.005130	0.006545
9	6.899352	0.262272	0.554994	0.119101	98.91944	0.130991	0.006133	0.007068
10	7.150074	0.304123	0.636454	0.142253	98.78059	0.122026	0.007120	0.007439
Variance Decomposition of TRADE								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	7.183104	6.498596	0.175369	3.059499	0.001998	90.26454	0.000000	0.000000
2	10.07066	7.168564	0.427771	2.178311	0.370121	89.50402	0.001086	0.350123
3	12.00058	5.686318	0.520538	1.769797	0.494679	90.69059	0.003176	0.834899
4	13.49858	4.682380	0.571854	1.522828	0.499597	91.46190	0.006240	1.255204
5	14.72827	3.983694	0.610599	1.343317	0.491407	91.94611	0.010203	1.614675
6	15.76815	3.487741	0.640831	1.201956	0.477634	92.26938	0.015056	1.907405
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF

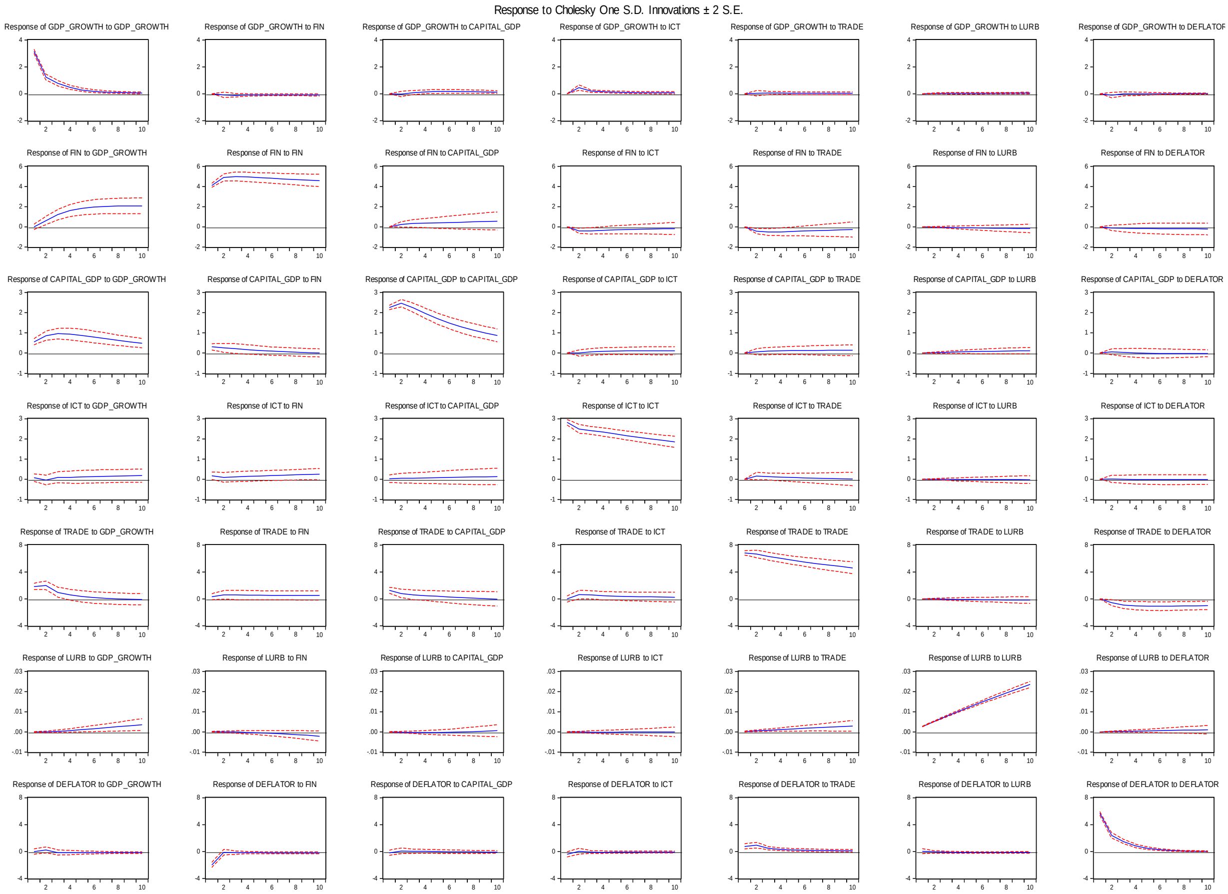
7	16.66403	3.124639	0.666659	1.087676	0.463307	92.49229	0.020838	2.144595
8	17.44556	2.850952	0.690011	0.995243	0.449637	92.64948	0.027605	2.337073
9	18.13361	2.639556	0.712113	0.921241	0.436913	92.76041	0.035418	2.494353
10	18.74361	2.472967	0.733743	0.862910	0.425147	92.83682	0.044341	2.624076
Variance Decomposition of LURB								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	0.002635	0.092240	0.030293	0.095101	0.078323	0.206225	99.49782	0.000000
2	0.005847	0.029409	0.008805	0.133902	0.062013	0.647456	99.05865	0.059765
3	0.009704	0.081864	0.019560	0.133830	0.047114	0.907717	98.71541	0.094506
4	0.014092	0.256160	0.045913	0.114365	0.033532	1.066424	98.36886	0.114743
5	0.018933	0.486184	0.086232	0.087213	0.024210	1.172420	98.01514	0.128599
6	0.024168	0.732277	0.139792	0.061066	0.017782	1.247426	97.66271	0.138952
7	0.029752	0.973550	0.206368	0.040958	0.013303	1.302768	97.31576	0.147292
8	0.035648	1.199858	0.285855	0.029324	0.010131	1.344862	96.97558	0.154387
9	0.041825	1.406660	0.378222	0.026939	0.007843	1.377608	96.64206	0.160667
10	0.048259	1.592393	0.483472	0.033588	0.006164	1.403513	96.31448	0.166391
Variance Decomposition of INF								
Period	S.E.	ECOG	FIN	CAPITAL	INN	TRADE	LURB	INF
1	6.104330	0.000480	10.80172	0.119964	0.515705	1.521882	0.001894	87.03836
2	6.627365	0.113015	9.206159	0.115802	0.439416	3.258316	0.014102	86.85319
3	6.807589	0.162899	8.807159	0.110747	0.438553	3.545013	0.043732	86.89190
4	6.869024	0.227841	8.718917	0.109005	0.463193	3.686187	0.086434	86.70842
5	6.895108	0.299383	8.734556	0.109038	0.486119	3.760722	0.135549	86.47463
6	6.909822	0.369983	8.786208	0.112802	0.506136	3.806618	0.186500	86.23175
7	6.920759	0.438035	8.850067	0.120581	0.523419	3.836796	0.236503	85.99460
8	6.930273	0.503486	8.916826	0.131567	0.538633	3.857882	0.284081	85.76752
9	6.939070	0.566224	8.982760	0.144772	0.552303	3.873407	0.328546	85.55199
10	6.947352	0.626201	9.046341	0.159374	0.564761	3.885342	0.369660	85.34832

Note: Cholesky Ordering: ECONOMIC GROWTH FIN CAPITAL INN TRADE LURBANIZATION INFLATION

The results show that the availability of physical capital, financial development, innovations, trade, and urbanization contribute to shocks of urbanization by 0.15%, 9.04%, 0.56%, 3.88%, and 0.36%, respectively. Overall, the feedback of effects results shows that financial development, availability of physical capital, innovations, trade, urbanization, and inflation play important roles in determining economic growth in developing countries.

Normally, the impulse response function is considered an alternative to the variance decomposition, and granger causality test. It can provide the causality between variables among different time horizons. The results of the impulse response function are given in Figure 1. The results show that the response of economic growth in financial development remains minimal and constant throughout the whole-time horizon. The figures explain that the response of economic growth in explaining physical capital, innovations, merchandised trade, urbanization and the inflation rate is constant and minimal throughout the whole-time horizon. The overall results of the impulse response function show that most of the selected variables are causing economic growth in the case of developing countries.

Figure 1. Impulse response function



Source: Author's Calculation

Conclusions

Based on the results and discussion, this study has major conclusions and policy suggestions. The present study has investigated the impact of innovations and financial development on economic growth. A sample of 58 developing countries has been selected for this purpose and data from 2000 to 2020 is used for empirical analysis. The results of unit root tests show that there is mix order of integration among the variables of the model. The results of the study show that financial development has a negative and significant impact on economic growth.

This shows that developing countries are unable to get the true benefits of financial development, so, with rising financial development, the economic growth of the developing countries is depressed. The results show that the availability of physical capital has a positive and significant impact on economic growth. Economic growth is directly related to economic and business activities, and these activities are directly linked to the availability of physical capital. Therefore, to raise the level of economic growth, developing countries arrange a sufficient amount of physical capital. Innovations have a positive and significant impact on economic growth. Innovations raise the productivity of the country with the help of sufficient utilization of resources, so developing countries should promote innovation to raise the level of economic growth. Trade has a positive and significant impact on economic growth.

Thus, there is a dire need to promote trade to enhance economic growth in developing countries. Urbanization and inflation hurt economic growth. So, to promote economic growth developing countries should encourage stable inflation with a rise in urbanization, in this way negative effects of urbanization can be overcome. Overall, this study suggests that developing countries should encourage the availability of physical capital, innovations, and trade to raise economic growth.

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