Financial Development and Innovation Led-Growth: A Case of Selected Developing Countries

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Abstract
To achieve higher economic growth is a main target of all economies throughout the world. Higher economic growth is determined by numerous factors and further it generates multiplier socioeconomics impact for the masses. This study has examined the role of financial development and innovation in deciding the level of economic growth in the case of developing countries for 2000-2020. Auto-Regressive Distributed Lag Model has been applied to examine the long-run and short-run coefficients of the model. The causality of the variables has been checked with the help of the Dumitrescu Hurlin Panel Causality test. The results show that the availability of physical resources, labor force participation and technological changes have significantly positive impact on economic growth of developing countries. R&D has a negative and significant impact on economic growth whereas financial development has a negative and insignificant impact on economic growth. The outcomes of the study show that there is no causal relationship between gross fixed capital formation and economic growth. A bidirectional causality is running between total labor force participation and economic growth, between financial development and economic growth. The results show that there is unidirectional causality is running from technological changes to economic growth, from R&D to economic growth of developing countries. The study recommends that developing countries can attain an improved level of economic growth, by raising gross fixed capital formation.
Key Words: economic growth, financial development, innovation, technological changes

1. Introduction

Higher economic progress has been the ultimate aim of every economy. According to Ricardo (1891), the total goods and services produced by a country as economic growth. The economy resembles a machine that changes contributions to yields and the quantity of data sources decides the quantity of results. After the second World War, the vast majority of the nations embraced forceful monetary strategies to further develop the development pace of genuine GDP (Crafts, 2000). Exogenous mechanical advancement and aggregation of variables of creation are viewed as the fundamental determinants of monetary development. Solow (1957) makes sense of that with actual contributions there are some nonphysical (expertise, information) factors for deciding consistent state financial development. Nelson and Phelps (1966) propose that the size and ability of work retain new innovation which is found somewhere else.

In this globalized era, innovations have become the part and parcel of economic growth (Solow, 1957; Romer, 1986). Innovations have considered an inherent tendency for humans to think differently and better as compared to their forefathers. Despite their obvious importance, innovations have not always been received the deserved attention from developing countries (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 the developing world (Schumpeter, 1939). During 1960, literature focused on the role of technological change in economic growth (Solow, 1957; Denison, 1962). Presently, a new 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, 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 develops emphasized in numerous theoretic and experimental studies (Solow, 1957; Mansfield, 1972; Romer, 1986). Most of these studies existed shown in the case of developed economies. Because developing countries have a lack of data and information related to innovations and growth (Bernier and Plouffe, 2019). In the last two decades, the new information technology has been responsible for rising economic activity's wealth creation been enhanced productivity (Gerguri and Ramadani, 2010). According to Gurbiel (2002) innovations have the potential to influence the economy, both macro and micro levels. The contributions of technological innovations in economic growth have been well established in the literature, both theoretically as well as empirically (Solow, 1957; Mansfield, 1972; Romer, 1986; Nadiri, 1993). A copious amount of literature is available also describes how innovations and entrepreneurship affect the economy (Porter, 1990; Baumol, 1993; Lumpkin and Dess, 1996). But still, many developing countries do not provide the true picture of the association among innovations and economic growth. So, the situation is fair toward

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say that the question of how technology and innovations influence economic growth is still a controversial issue and needs to be studied (Fagerberg & Srholec, 2008). Theoretically, the link between innovations, knowledge, and economic growth is well established (Marshall, 1890; Kuznets, 1971). 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 (Bell and Pavitt, 1993; Filippetti et al., 2013).

A financial market is a key factor in deciding the strong process of economic growth because efficient financial market divers' financial 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 and policymakers. This discussion as customarily spun around two issues: the first connects with whether development in the financial framework brings about quicker economic development and the second connects with what financial development means for economic growth. The financial system can acquire and process financial information effectively to increase the level of investment and enhance 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 through two channels: the capital a capital accumulation channel and the total factor productivity (TFP) channel. The primary channel, otherwise called the quantitative channel, is somewhat clear. Economic growth relies upon capital amassing through both homegrown and unfamiliar capital ventures. To activate investment funds and channel them to capital collection, a productive financial framework is fundamental. Along these lines, financial development and economic growth are connected. The TFP channel, which is alluded to as the qualitative channel, proposes that an effective financial framework works with the adoption of the present-day technology to help the development of the information and technology-escalated businesses, through the arrangement of productive credit offices and other financial administrations (Ang, 2008).

Creating economies and financial frameworks have prompted the normal reception of the idea of innovations in the financial field and the quest for the impacts of the idea of financial innovations. Since financial innovations with an emphasis on technology are impacting the organic market of cash in the economy and influencing growth (Atta-Mensah, 2004; Folarin and Asongu, 2019). The peculiarity of financial advancement, the beginning of examination on experimental examinations between financial development and economic growth (King and Levine, 1993). The connection between economic growth and financial development has started to be analyzed by laying out different models and adding factors or factors to the financial development pointers. To influence the growth of financial innovation, to add to the saving of impacts, for example, growth transforms into a speculation, it expanded the significance of this relationship. Since these impacts are straightforwardly connected with the financial intermediation movement. It is feasible to lay out the connection between financial development and economic growth as Investments need to increment for a country's economy to develop (Atta-Mensah, 2004; Folarin and Asongu, 2019). This study empirically investigates the link between innovations, financial development, and economic growth in the case of selected developing countries.

2. Literature Review

This part of the thesis is comprised of the literature review, the most relevant and recent studies have been taken as the literature review. 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. Roubini and Sala-i-Martin (1992) empirically and theoretically examine the link between long-term economic growth and policies of financial repression. The findings of this paper show that after controlling for policies of financial repression a regional dummy for Latin America in growth regressions tends to be insignificant. Mankiw et al., (1992) examine whether the Solow growth model is steady with the worldwide deviation in the ordinary of existing. The findings of this holding population growth and capital accumulation constant, countries converge at about the rate the augmented Solow model predicts.

King and Levine (1993) empirically examine the link between a wide range of indicators of financial development and economic growth for the case of 80 countries from 1960 -1989. This paper presents cross-country evidence dependable with Schumpeter's (1911) opinion that the financial system can promote economic growth. Wood (1993) examines the relationship between financial development and economic growth in Barbados. The findings of this study show evidence of a supply-leading causality pattern emphasizing the significance of financial development in the Barbadian economy.

De Gregorio and Guidotti (1995) examine the empirical relationship between long-run economic growth and financial development. The findings of this study show that the main channel of transmission from financial development to economic growth is efficiency rather than the volume of investment. Arestis and Demetriade (1997) re-examine causality between financial development and economic growth. The results justify the claim

that the importance of institutional considerations and policy differences are very vital for economic growth. The findings of this study show that financial development is very important for economic growth. Neusser and Kugler (1998) theoretically examine that the development of the financial sector is essential for economic growth. The findings of this paper that financial sector GDP is co-integrated for OECD countries with manufacturing total factor productivity and suggests a more complex picture than is apparent from cross-sectional evidence.

Ahmed and Ansari (1998) investigate the link between financial sector development and economic growth. The findings of this study show the supply-leading hypothesis for the LDCs, while it has maintained the demand-following suggestion for the developed countries. Akinboade (1998) examines the causality between financial development and economic growth. The results of this study indicate a bi-directional causality amongst the two financial development indicators and per capita income. The findings of this study strongly suggest that nearby is a bidirectional connection among financial development then economic growth in the case of Botswana. Cameron (1998) empirically investigates the link between innovation and economic growth. The findings of this study strongly support that technical hook-up may act to the level of productivity across states, the procedure is probable toward remain time-consuming and undefined, and demand considerable national innovative struggle.

Darrat (1999) empirically investigates the role of financial deepening in economic growth. The findings of this study are that government policies of these countries are promoting financial deepening and sustainability to foster economic development. Luintel and Khan (1999) examine the long-run relationship between financial development and economic growth. The findings of this analysis indication an advanced dimensional structure with a novel process of classifying the long-run economic relationships and long-run causality analysis in case of 10 developing countries. Levine et al., (2000) examine the effect of financial intermediary development on economic growth. The findings show a strong positive relationship between financial development and output growth. But finance development partly explains economic growth. The results support the idea of the growth-enhancing hypothesis of financial development. Xu (2000) examines the effects of perpetual financial development on domestic investment. The findings of this study show that financial development is significant to the development then that investing is an significant network complete which financial development assumes growing. Rousseau and Wachtel (2000) examine the relationship between equity markets and economic growth and also investigate the standard marketplace promotes economic growth. The findings of this study also indicate that emphasize the possible gains related to rising deep and liquid financial markets in a progressive universal economy.

Halifa Al-Yousif (2002) empirically examines the relationship between financial development and economic growth. The findings of the present study indicate that the association amongst financial development and economic growth cannot be comprehensive within countries as economic rules are country exact and their achievement be contingent between others. Christopoulos and Tsionas (2004) investigate the relationship between financial development and economic growth. The empirical results support that here remains a single equilibrium relation amid financial depth and economic growth. Unidirectional causality is successively since financial depth to economic growth. Wong et al., (2005) empirically examine the impact of technological innovations on economic growth in the case of new firm formation. The findings of the study are consistent with the existing literature that the fast-growing new firms do not account for most of the new job creation by small and medium enterprises in advanced countries. Shan (2005) empirically investigates the relationship between financial development and economic growth. The results of this analysis that financial development is an essential then perhaps necessary sign of economic growth.

Khan et al., (2005) empirically examine the relationship between financial development and economic growth. The findings of this study expression that a constant long-run relationship between economic growth and fiscal deepness and economic growth is an effect on financial development. Yang (2006) empirically investigates the role of innovation on economic growth and evaluates the relationship between innovations and economic growth. The findings of this study show that innovations are truly positively associated with long-run economic growth. Habibullah and Eng (2006) examine the causal relationship between financial development and economic growth. The result of this study is in agreement with other causality studies by Calderon & Liu (2003), Fase & Abma (2003), and Christopoulos & Tsionas (2004) that financial development promotes growth, thus supporting the old Schumpeterian hypothesis and Patrick's supply-leading hypothesis. Liang and Jian-Zhou (2006) investigate the relationship between financial improvement and economic growth at the city level in China. The results of this study recommend that the financial developments that have taken place after China's succession to the WTO are on the right track. Acaravci et al., (2007) examine the causal relationship between financial development and economic growth in Turkey. The results show a one-way causal relationship running from financial development to economic growth in Turkey. Afzal (2007) examines the Cross-national evidence on the relationship between population growth and economic growth. Results show that the highly significant and negative coefficient of population growth demonstrates that population growth is a real problem in Pakistan because it adversely affects economic growth.

Ozturk (2008) reviews the literature on financial development and economic growth nexus and investigates the connection between financial development and economic growth in Turkey aimed at the period 1975-2005. The empirical findings of this study show that unidirectional causality runs from economic growth in financial

development. LeBel (2008) empirically investigates export-driven rules that have led to significant rises in real per capita income. The findings of this study strongly suggest there is a positive role of advanced innovations in economic growth. Horbach (2008) empirically investigates environmental innovations based on firm-level data. The results of this study indicate that there is technological improvement in the environment, innovations by using the research and development indices. Acaravci et al., (2009) empirically investigate the relationship between financial development and economic growth. The empirical findings of this take a look at display the bi-directional causal connection among the boom of actual GDP in keeping with capita and the home credit score supplied through the banking zone for the panels of 24 sub-Saharan African countries. Ohiambo (2009) empirically investigates the way of connection between financial development and economic growth. The findings of this study show that the financial sector growth in Kenya is largely contingent on the supply of financial services. The results of this study also suggest that economic growth Granger causes inflation, while inflation Granger causes financial development in the case of Kenya. The effects of this analysis apply irrespective of whether the causality is assessed in the short run or the long run. Wolde-Rufael (2009) re-examines the contributory relationship between financial development and economic growth. The findings of this study show that financial development promotes economic growth in Kenya and Kenya must introduce further policies that improve and play a significant role in the development of the financial sector that can help to subdivision economic growth.

Yonezawa and Azeez (2010) empirically examine whether bank-based financial systems are better at promoting economic performance. The findings of this study suggest that financial structure does not matter for real economic performance while financial development does matter for high economic growth. Hasan and Tucci (2010) empirically investigate the significance of together the quantity and quality of innovation on economic growth, directing for past methods of creative inputs. The findings of this study strongly show that growth in the level of patenting also witnesses an attendant rise in economic growth. Demirhan et al., (2011) investigate the causality relationship between financial development and economic growth. The findings of this study, the contribution of the banking sector to economic growth are larger than the banking sector of the stock market.

Kar et al., (2011) empirically investigate the direction of causality between financial development and economic growth. Empirical results of this study indicate that there is no perfect direction of causality between financial development and economic growth. Jalil and Feridun (2011) empirically examine the impact of financial development on economic growth. The results of this study strongly suggest that there is a positive and significant relationship exists between financial development and economic growth. Hassan et al., (2011) empirically investigate the relationship between financial development and economic growth. The findings of this study show that there is a unidirectional causality that is run from economic growth and financial development. Zhang et al., (2011) examine the relationship between financial development and economic growth. The findings of this study indicate that in the short term if financial divisions in China improve well and offer more monetary services for economic actions, it will encourage Chinese economic growth. Guloglu and Tekin (2012) examine potential fundamental associations amongst research and development (R&D) expenditures, innovation, and economic growth. The results of this analysis strongly propose that technology impulse and demand-pull model of innovation similarly make intelligence.

Bayarcelik and Taşel (2012) empirically examine the relationship between innovation and economic growth. The results of this study indicate a positive and significant relation between Research and Development expenditure and the number of Research and Development employees in inducing economic growth. De Marchi (2012) examine the relationship between firms' Research and Development cooperation strategies and introduce environmental innovations. The findings of this study show that cooperation with trades does not seem to be differently significant. Petrariu et al., (2013) empirically examine the link between innovation and economic growth in the case of Central and Eastern European countries (CEE). The findings of this study are consistent with the existing literature that innovation makes a significant contribution to national competitiveness and economic growth. By investing in innovation gap between the Western and Eastern economies can be reduced. Ramadani et al., (2013) show that innovations' are essential for sustainable growth and development and it is one of the main key European Union (EU) strategies. The findings of this study strongly show the growing role of innovation in economic growth and development that can help society meet the global challenges of the 21st century. Satti et al., (2013) investigate the impact of financial development and globalization on inflation by incorporating foreign remittances and economic growth. Findings that financial development increases inflation and economic growth decline inflation, but foreign remittances increase it. The causality analysis reveals the bidirectional causality between financial development and inflation. Hsueh et al., (2013) empirically investigate the impact of causality between economic growth and financial development. The findings of this study strongly support that the supply leading hypothesis and financial development variables lead to economic growth in the circumstance of China.

Aggarwal et al., (2013) study explored the complex association between financial development and economic growth. Mhadhbi (2014) inspects the causal relationship between financial development and economic growth. The findings of this study show that the evidence on supply leading which is suggesting that financial development encourages economic growth. The results of this study strongly support that financial development does not depend on economic growth. Menyah et al., (2014) examine the causal association between financial development

and economic growth. The results also show that financial development and trade liberalization does not take a important impact on economic growth. Hsu et al., (2014) examine how financial market development affects innovation. The findings of this study indicate that the effect of financial development on innovations is more prominent in developing countries and developing countries with stronger stockholder defense, weaker creditor protection. Evidence of this study is strong to alternate proxies for financial development and innovation. Ali and Rehman (2015) empirically examine the impact of macroeconomic instability detrimental on the gross domestic product in the case of Pakistan. The findings of this study are that government should make appropriate policies for rising the leap of economic growth in Pakistan. Pece et al., (2015) examine the impact of innovation, research and development expenditures, and investments in technology on economic growth. The results of this study provide evidence of a positive relationship between economic growth and innovation. Tuna et al., (2015) empirically investigate the correlation between Research and Development (R&D) expenditures and economic growth at the national level in Turkey over the period 1990 to 2013. The findings of this study show that the series, inspected are stationary at first-order and have no co-integration relationship between them.

Inekwe (2015) examines the role of Research and Development expenditure on economic growth. Results also indicate that there is a positive effect of research and development expenditures on economic growth. The findings of this study show that there are different short and long-run effects on economic growth. Freimane and Bāliņa (2016) investigate the empirical relationship between research and development (R&D) expenditures and economic growth. The findings of this study show that the level of significance decreases as a sub-sample in the case of European Union countries. Aali-Bujari and Martínez (2016) empirically inspect the influence of technological innovation on economic growth. The main findings of this study show that investment in research, patents, and exports are relevant to raising the total factor productivity and increasing per capita Gross Domestic Products. Svirydzenka (2016) empirically investigates financial development with one of two measures of financial depth the ratio of isolated credit to Gross Domestic Products. The outcomes of this study show how developed financial institutions and financial markets are accessed, efficiency, and in terms of their depth through 9 indices which are used in this study. The findings of this study show that are these 9 indices used for financing development in this study are combined into an overall index. Durusu-Ciftci et al., (2017) empirically and theoretically consider the role of financial development on economic growth. The finding of this study after panel data analysis is that both channels consume confident results on the steady-state level of GDP per capita, and the influence of the credit markets is considerably greater. Bongini et al., (2017) evaluate the role of financial development in economic growth. The results of this study challenge the idea that bank credit fosters economic growth and that foreign-owned banks are indisputably a positive addition to local marketable to foster economic growth.

Audi and Ali (2019) investigate examine the effect of advancement in information and correspondence innovations (ICT) on economic development. The findings of this study strongly show that developing countries should introduce new and advanced information and correspondence innovations (ICT) for contending with the developed countries in the process of economic development. Mehta et al., (2021) analyze the relationship between the he role of remittances in financial development, evidence from nonlinear ARDL and asymmetric causality. The Long-run cointegration in the empirical model and beneficial outcome running from remittances inflow to financial development both over the long haul and short-run. Furthermore, the presence of long-run and short-run asymmetry. Usman & Hammar (2021) analyze the relationship. between mechanical innovations, financial development, renewable energy, and biological footprint. There is a dire requirement for building an aggregate platform (make consortia) to extend deepen arranging and coordination, R&D collaboration, reinforce combined efforts for cleaner innovation, encourage country-level trades, empower to share of eco-friendly innovation important role in environmental change. In this regard, the drawn-out projects from these APEC countries should be based on energy-productive innovation and spotless and modern energy sources that required more supporting.

3. The Model

There are a variety of factors that are responsible for the process of economic growth that may change over time (Smith, 1776). In 1957, Solow demonstrates that capital, labor, and technical progress play an important role in economic growth (Solow, 1957). Sala-i-Martín points out that the accumulation of physical capital, human capital, education, diversity of institutions, free movement of capital, technology, ideas, foreign investment, and the free flow of information is the main decider of economic growth (Sala-i-Martin, 2001). In the process of economic growth, innovations are considered the most important displays in the case of developed as well as developing countries (Posner, 1961; Bell and Pavitt, 1993; Schumpeter, 1939). The creation and adoption of new knowledge, improve the value of products, processes, and services. Product development has become the most important factor in the competitive environment (Tidd, 2006). In this study, we are following the neo-classical model of economic growth. The neo-growth model begins with Solow (1957), this model has three basic components for measuring economic growth, i.e. labor (L) capital (K), and technology (A).

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

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 hypnotize technology and encourage economic growth. This form of the economic growth model as:

$$Y = K^\alpha (AL)^{1-\alpha} \qquad (2)$$

Since the endogenous growth model allows us to include some additional variables for the determination of economic growth. The variations in financial development and R&D expenditures impact the level of economic growth. Following the extensive literature review, the functional form of the model becomes as:

$$GDP_{it} = F(GCF_{it}, LNLT_{it}, TC_{it}, R\&D_{it}, DC_{it},) \qquad (3)$$

GDP=Economic Growth (measured with the help of GDP growth rate)

GCF=Goss fixed capital formation as a percentage of GDP

LNLT= Total labor force participation

TC = Technological changes measured with help of Solow residuals sector

R&D = Research and development expenditures

DC = Financial development (% of total credit to private)

i= the country (65 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:

$$GDP_{it} = GCF^{\beta 1}_{it} LNLT^{\beta 2}_{it} TC^{\beta 3}_{it} R\&D^{\beta 4}_{it} DC^{\beta 5}_{it} U_{it} \qquad (4)$$

The econometric model of the study becomes as:

$$ECOG_{it} = A + \beta_1 GCF_{it} + \beta_2 LNLT_{it} + \beta_3 TC_{it} + \beta_4 R\&D_{it} + \beta_5 DC_{it} + U_{it} \qquad (5)$$

All the variables have explained above except A and U,

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.

This study has applied PP - Fisher Chi-square (PP-FC), ADF - Fisher Chi-square (ADF-FC), Im, Pesaran and Shin W-stat (IP&S), and Levin, Lin & Chu t*(LLC) unit root tests. Panel autoregressive distributive lag cointegration have been applied to find the long run and short run relationship among the explanatory and explained variables over the selected time period. Dumitrescu Hurlin panel causality test has been applied to check the causality among the selected variables.

4. Results and Discussions

This section of the study presents the estimated empirical results and discussion. The descriptive statistic presents the mean, standard deviation, median, minimum, maximum, Kurtosis, skewness, and Jarque-Bera values of the selected data set. Table 1 presents the descriptive statistic of the selected variables of the model. The overall results of the Table 4.1 reveal that gross fixed capital formation, total labor force, research & development expenditures, and financial development are positively Skewed, with positive Kurtosis. Whereas, economic growth and technological changes are negatively skewed with positive Kurtosis. The estimate values of the Jarque-Bera show that all the variables have zero mean and finite covariance, which also approves that all the variables are normally distributed.

Table-1

Descriptive Statistics						
	GDP	GCF	LNLT	TC	R&D	DC
Mean	3.743731	23.76297	15.70395	-9.34E-16	6.974553	38.59310
Median	4.150813	22.22029	15.65728	0.420736	5.009655	29.32293
Maximum	19.67532	53.98797	20.49103	16.53280	51.47694	182.4326
Minimum	-21.46427	1.525177	11.75559	-23.28969	0.318499	0.007425
Std. Dev.	3.793321	8.027329	1.649150	3.652353	6.443231	30.16680
Skewness	-1.266964	0.780547	0.325497	-1.202120	2.991959	1.468723
Kurtosis	8.558530	3.835353	3.401783	8.560930	14.46466	5.243613
Jarque-Bera	2122.464	178.2935	33.28455	2087.558	9512.104	777.0485
Sum	5110.193	32436.46	21435.89	-1.23E-12	9520.265	52679.58
Sum Sq. Dev.	19626.99	87893.44	3709.666	18195.33	56626.76	1241289.
Observations	1365	1365	1365	1365	1365	1365

The results of the correlation among the variables have been presented in table 2. The results of the correlation matrix show that most of the explanatory variables have a positive and significant correlation with economic

growth being the dependent variable of the panel regression model. The results also express that most of the explanatory variables have a significant correlation among individually, but this correlation is not so high to create the issue of multicollinearity between the variables of the panel regression analysis.

This study is using data for 2000 to 2020, so, for such a range of panel data, it is necessary to check the stationarity of the data. Moreover, before examining the relationship among the variables, the stationarity of the variables is a prerequisite. The results show that some variables are stationary at a level and some are stationary at the first difference, thus there is a mixed order of integration among the variables of the model, which is the most suitable situation to apply panel autoregressive distributed lag model.

This study analyses the relationship between financial development and innovation-led growth in the case of developing countries for 2000 to 2020. Normally, sequential modified LR test statistics, final prediction error, Akaike information criterion, Schwarz information criterion, and Hannan-Quinn information criterion are used for lag order selection. The results of the VAR lag order selection have been presented in table 4. Based on SC, and HQ, this study has used a maximum of two lags for empirical analysis.

The estimated long-run results have been given in table 5. Capital formation works like the lifeblood of the economy. Empirical studies (Barro, 1997; Barro & Sala-i-Martin, 2004; Eaton & Kortum, 2001; Kim & Lau, 1994, Lau & Park, 2003) mention that capital formation is the main indicator that decides the level of economic growth of the nations. The estimated results show that gross fixed capital formation has a positive and significant effect on economic growth. The value for the coefficient reveals that a 1 percent increase in gross fixed capital formation brings (0.090015) percent increase in the economic growth of selected developing countries. This relationship is significant at a 1 percent level of significance. Our estimated results remain reliable with the findings of Bleaney et al., (2001), Freire-Seren (2002), Anaman (2004), Acikgoz and Mert (2014), Bayraktar (2006), Asheghian (2009), and Checcherita-Westphal and Rother (2012). Based on estimated results, we can reject the null hypothesis and accept the alternative. This is approved that gross fixed capital formation is positively and significantly impacting the economic growth of the selected developing countries.

Following the traditional Solow model (1957), the labor force is the main determinant of economic growth, the higher the number of working people, the higher will be overall economic growth of the economy. Lucas (1988), Romer (1986), Fischer 1992; Knight et al., (1993), Easterly and Levine (1997), Chen and Feng (2000), Freire-Seren (2002), Bayraktar (2006), Anyanwu (2014), and Topel (1999) mention that human capital has a positive and significant position in deciding economic growth. There are some studies (Hamilton and Monteagudo, 1998; Benos and Zotou, 2014) that highlight that labor force participation has a negative and significant impact on economic growth. The coefficient of labor force participation shows that the total labor force has a positive and significant influence on economic growth over the selected period. A 1 percent increase in total labor force brings (9.080832) percent increase in economic growth in the case of developing countries. This relationship is significant at a 5 percent level of significance. Although developing countries cover most of the world's population, the still-rising labor force has a positive effect on economic growth. Thus, based on our estimated results, we can reject the null hypothesis and accept the alternative. This is approved that the labor force is positively and significantly contributing to the economic growth of developing countries.

Presently, with rising linkage among the countries, technology is becoming the main determinant of economic growth (Von Tunzelmann, 1995; Lee and Tan, 2006; Freeman, 2013; Edquist, 2013; Best, 2018). Numerous academicians and researchers have focused on studying the impact of technological changes on economic growth at the industry level, the national level, and the cross-country level (Pradhan et al., 2018; Raghupathi and Raghupathi, 2019; Cheng et al., 2021). Our results show that technological changes have a positive and significant impact on economic growth. This reveals that with rising technological advancement, new and easy methods of production are developed. So, technology encourages economic growth in the case of developing countries. The results reveal that a 1 percent increase in innovations, (1.029587) percent increase is occurring in the economic growth of developing countries and this relationship is significant at 1 percent. Thus, based on our estimated results, we can reject the null hypothesis and accept the alternative. This is approved that technological changes are positively and significantly contributing to the economic growth of developing countries. Our results are consistent with (Du and Li, 2019; Appiah-Otoo and Song, 2021).

Table-2

Correlation Matrix						
Variables	GDP	GCF	LNLT	TC	R&D	DC
GDP	1.000000					
GCF	0.248119***	1.000000				
LNLT	0.175137***	0.217467***	1.000000			
TC	0.962838***	5.71E-16	0.063849**	1.000000		
R&D	0.099058***	0.039070	0.343731***	0.059712**	1.000000	
DC	-0.038336	0.280411***	0.176392***	-0.142115***	0.430287***	1.000000

Note: ***, **, *, 1%, 5%, 10% level of significance.

Table-3: Unit Root Tests Results

Variables	Test	Statistic	Prob**	Cross-Section	Obs
GDPI(0)	Levin, Lin & Chu t*	7.49311	1.0000	65	1235
	Im, Pesaran and Shin W-stat	-2.31447	0.0103	65	1235
	ADF - Fisher Chi-square	195.566	0.0002	65	1235
	PP - Fisher Chi-square	345.242	0.0000	65	1300
GCF I(0)	Levin, Lin & Chu t*	-2.30737	0.0105	65	1235
	Im, Pesaran and Shin W-stat	-1.92810	0.0269	65	1235
	ADF - Fisher Chi-square	151.338	0.0971	65	1235
	PP - Fisher Chi-square	169.022	0.0121	65	1300
LNLT I(0)	Levin, Lin & Chu t*	-7.62348	0.0000	65	1235
	Im, Pesaran and Shin W-stat	0.32925	0.6290	65	1235
	ADF - Fisher Chi-square	117.596	0.7744	65	1235
	PP - Fisher Chi-square	156.639	0.0557	65	1300
TC I(0)	Levin, Lin & Chu t*	7.23459	1.0000	65	1235
	Im, Pesaran and Shin W-stat	-2.05966	0.0197	65	1235
	ADF - Fisher Chi-square	199.815	0.0001	65	1235
	PP - Fisher Chi-square	480.862	0.0000	65	1300
R&DI(0)	Levin, Lin & Chu t*	-5.88966	0.0000	65	1235
	Im, Pesaran and Shin W-stat	-4.94899	0.0000	65	1235
	ADF - Fisher Chi-square	235.357	0.0000	65	1235
	PP - Fisher Chi-square	287.367	0.0000	65	1300
DC I(0)	Levin, Lin & Chu t*	0.90750	0.8179	65	1235
	Im, Pesaran and Shin W-stat	4.79087	1.0000	65	1235
	ADF - Fisher Chi-square	96.9888	0.9864	65	1235
	PP - Fisher Chi-square	70.8227	1.0000	65	1300
dGDP I(1)	Levin, Lin & Chu t*	-5.28540	0.0000	65	1170
	Im, Pesaran and Shin W-stat	-16.7434	0.0000	65	1170
	ADF - Fisher Chi-square	538.301	0.0000	65	1170
	PP - Fisher Chi-square	1928.61	0.0000	65	1235
dGCF I(1)	Levin, Lin & Chu t*	-13.9251	0.0000	65	1170
	Im, Pesaran and Shin W-stat	-14.6128	0.0000	65	1170
	ADF - Fisher Chi-square	459.843	0.0000	65	1170
	PP - Fisher Chi-square	923.379	0.0000	65	1235
dLNLT I(1)	Levin, Lin & Chu t*	10.7347	1.0000	65	1170
	Im, Pesaran and Shin W-stat	0.76781	0.7787	65	1170
	ADF - Fisher Chi-square	145.298	0.1698	65	1170
	PP - Fisher Chi-square	209.983	0.0000	65	1235
dTC I(1)	Levin, Lin & Chu t*	-4.55937	0.0000	65	1170
	Im, Pesaran and Shin W-stat	-16.9351	0.0000	65	1170
	ADF - Fisher Chi-square	542.660	0.0000	65	1170
	PP - Fisher Chi-square	1827.07	0.0000	65	1235
dR&DI(1)	Levin, Lin & Chu t*	-16.8570	0.0000	65	1170
	Im, Pesaran and Shin W-stat	-19.4187	0.0000	65	1170
	ADF - Fisher Chi-square	606.546	0.0000	65	1170
	PP - Fisher Chi-square	1907.14	0.0000	65	1235
dDC I(1)	Levin, Lin & Chu t*	-11.0205	0.0000	65	1170
	Im, Pesaran and Shin W-stat	-12.6371	0.0000	65	1170
	ADF - Fisher Chi-square	413.820	0.0000	65	1170
	PP - Fisher Chi-square	755.032	0.0000	65	1235

Table-4

Lag	LogL	LR	FPE	AIC	SC	HQ
		VAR Lag Order Selection Criteria				
0	-13667.90	NA	4578998.	32.36425	32.39791	32.37715
1	-2831.036	21494.18	3.62e-05	6.800085	7.035650	6.890344
2	-2696.445	265.0402	2.86e-05	6.566734	7.004211*	6.734358*
3	-2630.306	129.3041	2.67e-05*	6.495399*	7.134789	6.740387
4	-2605.200	48.72591	2.74e-05	6.521184	7.362486	6.843537
5	-2577.613	53.15078	2.79e-05	6.541095	7.584310	6.940813
6	-2541.222	69.59543	2.79e-05	6.540169	7.785297	7.017252
7	-2506.828	65.28744*	2.80e-05	6.543971	7.991011	7.098418
8	-2496.443	19.56408	2.98e-05	6.604600	8.253553	7.236412

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Different studies (Stevens and Weale, 2004; Hanushek and Woessmann, 2010; Wang and Liu, 2016) have mentioned that level of education impact the economic growth of a nation's research & development expenditures (R&D). Thus, the creation of new knowledge can be promoted with the help of R&D (Foray et al., 2012; Xu and Zeng, 2021). This shows that R&D can contribute to deciding the level of economic growth among the countries (Nelson and Phelps, 1996; Cohen and Levinthal, 1989). Our estimated results show that R&D has a negative and significant impact on economic growth in the case of developing countries. The results reveal that a 1 percent increase in R&D expenditures would bring (-0.029533) percent decrease in economic growth. The estimates explain that R&D expenditures of developing countries are inefficiently utilized, which is why around is a negative association between R&D expenditures and economic growth. Some factors may contribute to this inefficient utilization of R&D expenditures e.g., corruption, lack of policies option (Ades and Di Tella, 1997; Haapanen et al., 2014; Sulehri and Naeem, 2018; Naeem and Sulehri, 2019; Sulehri and Khan, 2020; Sulehri and Ali, 2020; Sulehri et al., 2021; Sulehri and Sharif, 2022; Audi et al., 2022).

The coefficient shows that there is a negative and insignificant relationship between financial development and economic growth in developing countries. This shows that developing countries are unable to get the true benefits of financial development, with rising financial development, the economic growth of the developing countries is depressed. This inverse relationship reveals that there may be higher corruption which may be the biggest obstacle in the way of financial development to impact economic growth in the case of developing countries. Previous literature (Kindleberger, 1978; Minskey, 1991; Manu et al., 2011; Senturk and Ali, 2021; Senturk and Ali, 2022; Senturk, 2021; Sulehri et al., 2022) considers financial development an important indicator of economic growth. Rioja and Valev (2004) mention that financial development hurts economic growth in the case of some African countries. Based on estimated results, we cannot reject the null hypothesis. This is approved that financial development has an insignificant impact on the economic development of the selected developing countries completed the selected period.

Table-5: Long Run Results

Dependent Variable: GDP	
Variables	Coefficient
GCF	0.090015***
LNLT	9.080832**
TC	1.029587***
R&D	-0.029533**
DC	-0.000813

Note: ***, **, *, 1%, 5%, 10% level of significance.

After analyzing the long-run relationship of the variables of the model, now with the help of vector error correction, we can estimate the short-run coefficient of the selected variables of the model. The short-run results have been given in table 6. The results show that gross fixed capital formation has a positive and significant effect on economic growth, the estimated coefficient explains that a 1 percent rise in gross fixed capital brings (0.099071) percent increase in economic growth. These results are steady with the estimated long-run outcomes. The short-run outcomes show that total labor force participation has a positive and significant impact on economic growth. The results show that a 1 percent increase in total labor force participation brings (0.132705) percent

increase in economic growth in the case of developing countries. These findings are consistent with the long-run outcomes of the study. The results reveal that technological changes have a positive and significant impact on economic growth. The results show that a 1 percent increase in technological changes brings (0.999707) percent rise in the economic growth of developing countries. These findings are consistent with the estimated long-run outcomes of the study. The short results show that R&D expenditures and financial development have an insignificant impact on economic growth, these findings are inconsistent with the estimated long-run outcomes of the study. For checking the convergence from short run to long run, the error correction term can be used. Theoretically, it should be negative and significant for the converge and short-run error correction. The estimated results of the error correction term show that show run deviations are converged in long run. These findings are theoretically correct and give strength to our estimated long-run results.

Table-6: Short Run Results

Dependent Variable: GDP	
Variables	Coefficient
D(GCF)	0.099071***
D(LNLT)	0.132705**
D(TC)	0.999707***
D(R&D)	2.86E-08
D(DC)	-1.90E-06
C	-0.050569**
ECT	-0.000302***

Note: ***, **, *, 1%, 5%, 10% level of significance.

Table-7: Dumitrescu Hurlin Panel Causality Tests

Developing Countries

GCF	▬▬▬	GDP
LNLT	⟺	GDP
TC	⟹	GDP
R&D	⟹	GDP
DC	⟺	GDP
LNLT	⟸	GCF
TC	⟸	GCF
R&D	⟸	GCF
DC	⟸	GCF
TC	⟺	LNLT
R&D	⟸	LNLT
DC	⟺	LNLT
R&D	⟺	TC
DC	⟺	TC
DC		R&D

Note: Bidirectional Causality ⟺
Unidirectional Causality ⟸
No Causality ▬▬

For checking the direction of the relationship among the variables, Dumitrescu Hurlin Panel Causality test has been used. The outcomes of the Dumitrescu Hurlin Panel Causality test consume been presented in table 7. The outcomes expression that there is no causal relationship between gross fixed capital formation and economic growth. There is bidirectional causality existed between economic growth and total labor force participation, between financial development and economic growth in developing countries. There is a unidirectional causality running from technological changes and R&D expenditures to economic growth in developing countries. The expected outcomes expression that there is unidirectional causality is administration from gross fixed capital formation to total labor force participation, technological changes, R&D expenditures, and financial development in the case of developing countries. Bidirectional causality has existed between total labor force participation and technological changes, between total labor force participation and financial development. A unidirectional causality is running from total labor force participation to R&D expenditures. The outcomes expression that there is bidirectional causality is running between financial development and technological changes. The estimated outcomes show that unidirectional causality is running from R&D expenditures to technological changes, from financial development to R&D expenditures. The overall causality test outcomes show that most of the selected variables have a causal relationship with each other in the case of selected developing countries.

5. Conclusions

Based on estimated results and discussions, this study has some major conclusions. The outcomes of Levin, Lin & Chu t*, Im, Pesran and Shin W-stat, ADF-Fished Chi-square and PP-Fished Chi-square unit root tests show that some variables are stationary at a level whereas some are stationary at first difference. Thus, there is mixed order of integration, this mixed order of integration enables us to apply an autoregressive distributed lag model. Based on long-run results, it is concluded that availability of physical resources, labor force participation and technological changes have a positive significant impact on economic growth in the case of developing countries. R&D has a negative and significant impact on economic growth whereas financial development has a negative and insignificant impact on economic growth. The short-run outcomes show that availability of physical resources, labor force participation, and technology have a positive significant impact on economic growth in developing countries, and these outcomes are similar to a long-run relationship. The results show that R&D has a positive and insignificant impact on economic growth in the short run, this is an inverse relationship to the long run. Financial development has a negative and insignificant impact on economic growth in the case of developing countries, this is a similar outcome in long run as well. The outcomes of the study show that there is no causal relationship between gross fixed capital formation and economic growth. A bidirectional causality is running between total labor force participation and economic growth, between financial development and economic growth. the results show that around is unidirectional causality is running from technological changes to economic growth, from R&D to economic growth in the case of developing countries. This analysis has expended fixed capital formation, total labor force participation, technological changes, R&D expenditures, and financial development as explanatory variables. The causality test outcomes show that most of these selected variables have a fundamental relationship through respectively added in the case of selected developing countries. Based on outcomes, it is concluded developing countries have innovation-led economic growth.

6. Policy Suggestions

Based on estimated results, discussions, and conclusions, there are some policy implications recommended to developing countries to achieve an improved horizontal of economic growth. The result shows that gross fixed capital formation has a positive and significant impact on economic growth. Thus, it is suggested that developing countries should improve the availability of fixed capital formation, as capital is considered the blood of an economy. The results show that total labor force participation has a positive and significant impact on economic growth. The empirics show that developing countries don't have less amount of labor force, but there is a need to improve the quality of the available labor force. For improving the quality of labor, there is a need to provide proper technical education, this further improves the level of economic growth. The results show technological changes have a positive and significant impact on economic growth. With every passing day, technology is becoming unique of highest factors of economic growth, through the help of technology by fixed labor and capital higher economic growth can be achieved. So, developing countries should improve the level of technology for raising the level of economic growth. R&D expenditures have a negative and significant impact on economic growth. Theoretically, there must be a positive and significant relationship between R&D expenditures and the level of economic growth, but in the case of developing countries, R&D expenditures hurt economic growth. It may be fewer expenditures on R&D or maybe too high corruption and bad governance. Thus, for higher economic growth developing countries should raise funds for R&D and control corruption, and improve governance structure. Financial development has a negative and significant impact on economic growth. Theoretically, there must be a positive and important relationship between financial development and the level of economic growth, but in the case of developing countries, financial development hurts economic growth. It may be because of less independence of monetary policy. Thus, developing countries should liberalize monetary policy to raise financial development, which further generates positive impact on economic growth.

References

Aali-Bujari, A., & Venegas Martínez, F. (2016). Technological innovation and economic growth in Latin America. *Revista mexicana de economía y finanzas*, *11*(2), 77-89.

Abu-Bader, S., & Abu-Qarn, A. (2005). Financial development and economic growth: time series evidence from Egypt,14(5),1-35

Abu-Bader, S., & Abu-Qarn, A. S. (2008). Financial development and economic growth: empirical evidence from six MENA countries. *Review of Development Economics*, *12*(4), 803-817.

Acaravci, A., Ozturk, I., & Acaravci, S. K. (2007). Finance-growth nexus: Evidence from Turkey. *Available at SSRN 1104693*.

Acaravci, S. K., Ozturk, I., & Acaravci, A. (2009). Financial development and economic growth: Literature survey and empirical evidence from Sub-Saharan African countries. *South African Journal of Economic and Management Sciences*, *12*(1), 11-27.

Acikgoz, S., & Mert, M. (2014). Sources of Growth Revisited: The importance of the nature of technological progress. *Journal of Applied Economics*, *17*(1), 31-62.

Ades, A., & Di Tella, R. (1997). The new economics of corruption: a survey and some new results. *Political Studies*, *45*(3), 496-515.

Adu, G., Marbuah, G., & Mensah, J. T. (2013). Financial development and economic growth in Ghana: does the measure of financial development matter? *Review of Development finance*, *3*(4), 192-203.

Afzal, M. (2007). The impact of globalisation on economic growth of Pakistan. *The Pakistan Development Review*, ,46(4),723-734.

Aggarwal, S. C., & Mehra, Y. S. (2013). Financial Development and Economic Growth: Evidence from India. *Prajnan*, *42*(3),1-12.

Ahmed, S. M., & Ansari, M. I. (1998). Financial sector development and economic growth: The South-Asian experience. *Journal of Asian Economics*, *9*(3), 503-517.

Akinboade, O. A. (1998). Financial development and economic growth in botswana: a test for causality/développement financier et croissance économique au botswana: un test de causalité. *Savings and Development*, 331-348.

Ali, A., & Rehman, H. U. (2015). Macroeconomic instability and its impact on gross domestic product: an empirical analysis of Pakistan. *Pakistan Economic and Social Review*, 53(2),285-316.

Al-Yousif, Y. K. (2002). Financial development and economic growth: another look at the evidence from developing countries. *Review of financial economics*, *11*(2), 131-150.

Anaman, K. A. (2004). Determinants of economic growth in Brunei Darussalam. *Journal of Asian Economics*, *15*(4), 777-796.

Ang, J. B. (2008). A survey of recent developments in the literature of finance and growth. *Journal of economic Surveys*, *22*(3), 536-576.

Anyanwu, J. C. (2014). Factors affecting economic growth in Africa: are there any lessons from China? *African Development Review*, *26*(3), 468-493.

Appiah-Otoo, I., & Song, N. (2021). The impact of ICT on economic growth-Comparing rich and poor countries. *Telecommunications Policy*, *45*(2), 102082.

Arestis, P., & Demetriades, P. (1997). Financial development and economic growth: assessing the evidence. *The economic journal*, *107*(442), 783-799.

Asheghian, P. (2009). Determinants of economic growth in Japan: The role of foreign direct investment. *Global Economy Journal*, *9*(3), 1850171.

Atta-Mensah, J. (2004). *Money demand and economic uncertainty* (No. 2004-25). Bank of Canada.

Audi, M., & Ali, A. (2019). The advancement in Information and Communication Technologies (ICT) and economic development: a panel analysis.

Audi, M., Sulehri, F. A., Ali, A., & Al-Masri, R. (2022). An Event Based Analysis of Stock Return and Political Uncertainty in Pakistan: Revisited. *International Journal of Economics and Financial Issues*, 12(5), 39-56.

Bara, A., & Mudzingiri, C. (2016). Financial innovation and economic growth: evidence from Zimbabwe. *Investment management and financial innovations*, (13, Iss. 2), 65-75.

Barguellil, A. (2021). The Asymmetric Indirect Impact of Real Exchange Rate on Economic Growth through Foreign Trade: An Asymmetric ARDL Panel Model. *Asian Economic and Financial Review*, *11*(8), 658-671.

Barro, R. J. (1991). Economic growth in a cross section of countries. *The quarterly journal of economics*, *106*(2), 407-443.

Barro, R. J. (2001). Human capital and growth. *American economic review*, *91*(2), 12-17.

Barro, R., & Sala-i-Martin, X. (2004). Economic growth second edition.

Baumol, W. J. (1993). Formal entrepreneurship theory in economics: Existence and bounds. *Journal of business venturing*, *8*(3), 197-210.

Bayarcelik, E. B., & Taşel, F. (2012). Research and development: source of economic growth. *Procedia-Social and Behavioral Sciences*, *58*, 744-753.

Bayraktar, B. (2006). Investigation on sources of growth for Turkey. *Canadian Journal of Development Studies/Revue canadienne d'études du développement*, *27*(1), 25-38.

Bell, M., & Pavitt, K. (1993). Technological accumulation and industrial growth: Contrasts between.1011-4211

Benos, N., & Zotou, S. (2014). Education and economic growth: A meta-regression analysis. *World Development*, *64*, 669-689.

Berg, A., Ostry, J. D., & Zettelmeyer, J. (2012). What makes growth sustained?. *Journal of Development Economics*, *98*(2), 149-166.

Bernier, M., & Plouffe, M. (2019). Financial innovation, economic growth, and the consequences of macroprudential policies. *Research in Economics*, *73*(2), 162-173.

Best, M. (2018). *How growth really happens*. Princeton University Press.

Bhattacharya, P. C., & Sivasubramanian, M. N. (2003). Financial development and economic growth in India: 1970–1971 to 1998–1999. *Applied Financial Economics*, *13*(12), 925-929.

Bleaney, M., Gemmell, N., & Kneller, R. (2001). Testing the endogenous growth model: public expenditure, taxation, and growth over the long run. *Canadian Journal of Economics/Revue canadienne d'économique*, *34*(1), 36-57.

Bongini, P., Iwanicz-Drozdowska, M., Smaga, P., & Witkowski, B. (2017). Financial development and economic growth: The role of foreign-owned banks in CESEE countries. *Sustainability*, *9*(3), 335.

Calderón, C., & Liu, L. (2003). The direction of causality between financial development and economic growth. *Journal of development economics*, *72*(1), 321-334.

Cameron, G. (1998). Economic growth in the information age: from physical capital to weightless economy. *Journal of International Affairs*, 447-471.

Checherita-Westphal, C., & Rother, P. (2012). The impact of high government debt on economic growth and its channels: An empirical investigation for the euro area. *European economic review*, *56*(7), 1392-1405.

Chen, B., & Feng, Y. (2000). Determinants of economic growth in China: Private enterprise, education, and openness. *China Economic Review*, *11*(1), 1-15.

Cheng, C. Y., Chien, M. S., & Lee, C. C. (2021). ICT diffusion, financial development, and economic growth: An international cross-country analysis. *Economic modelling*, *94*, 662-671.

Christopoulos, D. K., & Tsionas, E. G. (2004). Financial development and economic growth: evidence from panel unit root and cointegration tests. *Journal of development Economics*, *73*(1), 55-74.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and learning: the two faces of R & D. *The economic journal*, *99*(397), 569-596.

Crafts, N. (2000). Globalization and growth in the twentieth century.

Darrat, A. F. (1999). Are financial deepening and economic growth causally related? Another look at the evidence. *International Economic Journal*, *13*(3), 19-35.

De Gregorio, J., & Guidotti, P. E. (1995). Financial development and economic growth. *World development*, *23*(3), 433-448.

De Marchi, V. (2012). Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. *Research policy*, *41*(3), 614-623.

Demetriades, P. O., & Hussein, K. A. (1996). Does financial development cause economic growth? Time-series evidence from 16 countries. *Journal of development Economics*, *51*(2), 387-411.

Demirhan, E., Aydemir, O., & Inkaya, A. (2011). The direction of causality between financial development and economic growth: evidence from Turkey. *International Journal of Management*, *28*(1), 3.

Denison, E. F. (1962). Education, economic growth, and gaps in information. *Journal of Political Economy*, *70*(5, Part 2), 124-128.

Du, K., & Li, J. (2019). Towards a green world: How do green technology innovations affect total-factor carbon productivity. *Energy Policy*, *131*, 240-250.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic modelling*, *29*(4), 1450-1460.

Durusu-Ciftci, D., Ispir, M. S., & Yetkiner, H. (2017). Financial development and economic growth: Some theory and more evidence. *Journal of policy modeling*, *39*(2), 290-306.

Easterly, W., & Levine, R. (1997). Africa's growth tragedy: policies and ethnic divisions. *The quarterly journal of economics*, 1203-1250.

Easterly, W., Ritzen, J., & Woolcock, M. (2006). Social cohesion, institutions, and growth. *Center for Global Development Working Paper*, (94).

Eaton, J., & Kortum, S. (2001). Technology, trade, and growth: A unified framework. *European economic review*, *45*(4-6), 742-755.

Edquist, C. (2013). *Systems of innovation: technologies, institutions and organizations*. Routledge.

Fagerberg, J., & Srholec, M. (2008). National innovation systems, capabilities and economic development. *Research policy*, *37*(9), 1417-1435.

Fischer, S. (1992). Macroeconomic stability and growth. *Cuadernos de Economía*, *29*(87), 171-186.

Folarin, O. E., & Asongu, S. A. (2019). Financial liberalization and long-run stability of money demand in Nigeria. *Journal of Policy Modeling*, *41*(5), 963-980.

Foray, D., Mowery, D. C., & Nelson, R. R. (2012). Public R&D; and social challenges: What lessons from mission R&D; programs?. *Research policy*, *41*(ARTICLE), 1697-1702.

Freeman, C. (2013). *Economics of industrial innovation*. Routledge.

Freimane, R., & Bāliņa, S. (2016). Research and development expenditures and economic growth in the EU: A panel data analysis. *Economics and Business*, *29*(1), 5-11.

Freire-Seren, M. J. (2002). On the relationship between human capital accumulation and economic growth. *Applied Economics Letters*, *9*(12), 805-808.

Gault, F. (2018). Defining and measuring innovation in all sectors of the economy. *Research policy*, *47*(3), 617-622.

Gerguri, S., & Ramadani, V. (2010). The impact of innovation into the economic growth.

Ghali, K. H. (1999). Financial development and economic growth: The Tunisian experience. *Review of Development Economics*, *3*(3), 310-322.

Ghauri, P. N., & Holstius, K. (1996). The role of matching in the foreign market entry process in the Baltic States. *European journal of marketing*.

Ghirmay, T. (2004). Financial development and economic growth in Sub-Saharan African countries: evidence from time series analysis. *African Development Review*, *16*(3), 415-432.

Guloglu, B., & Tekin, R. B. (2012). A panel causality analysis of the relationship among research and development, innovation, and economic growth in high-income OECD countries. *Eurasian Economic Review*, *2*(1), 32-47.

Gurbiel, R. (2002). Impact of innovation and technology transfer on economic growth: the central and Eastern Europe experience. *Warshaw School of Economics*, *162*, 1-18.

Haapanen, M., Lenihan, H., & Mariani, M. (2014). Government policy failure in public support for research and development. *Policy Studies*, *35*(6), 557-575.

Habibullah, M. S., & Eng, Y. K. (2006). Does financial development cause economic growth? A panel data dynamic analysis for the Asian developing countries. *Journal of the Asia Pacific Economy*, *11*(4), 377-393.

Hadri, K. (2000). Testing for stationarity in heterogeneous panel data. *The Econometrics Journal*, *3*(2), 148-161.

Hamilton, J. D., & Monteagudo, J. (1998). The augmented Solow model and the productivity slowdown. *Journal of Monetary Economics*, *42*(3), 495-509.

Hanushek, E. A., & Woessmann, L. (2010). Education and economic growth. *Economics of education*, *60*, 67.

Hasan, I., & Tucci, C. L. (2010). The innovation–economic growth nexus: Global evidence. *Research policy*, *39*(10), 1264-1276.

Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial development and economic growth in the organization of Islamic conference countries. *Journal of King Abdul Aziz University: Islamic Economics*, *24*(1), 145-172.

Hassan, M. K., Sanchez, B., & Yu, J. S. (2011). Financial development and economic growth: New evidence from panel data. *The Quarterly Review of economics and finance*, *51*(1), 88-104.

Hausmann, R., Rodriguez, F. R., & Wagner, R. A. (2006). Growth collapses.

Horbach, J. (2008). Determinants of environmental innovation—New evidence from German panel data sources. *Research policy*, *37*(1), 163-173.

Hsu, P. H., Tian, X., & Xu, Y. (2014). Financial development and innovation: Cross-country evidence. *Journal of financial economics*, *112*(1), 116-135.

Hsueh, S. J., Hu, Y. H., & Tu, C. H. (2013). Economic growth and financial development in Asian countries: A bootstrap panel Granger causality analysis. *Economic Modelling*, *32*, 294-301.

Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of econometrics*, *115*(1), 53-74.

Inekwe, J. N. (2015). The contribution of R&D expenditure to economic growth in developing economies. *Social indicators research*, *124*(3), 727-745.

Ireland, P. N. (1994). Economic growth, financial evolution, and the long-run behavior of velocity. *Journal of Economic Dynamics and Control*, *18*(3-4), 815-848.

Jalil, A., & Feridun, M. (2011). Impact of financial development on economic growth: empirical evidence from Pakistan. *Journal of the Asia Pacific Economy*, *16*(1), 71-80.

Jung, W. S. (1986). Financial development and economic growth: international evidence. *Economic Development and cultural change*, *34*(2), 333-346.

Kar, M., Nazlıoğlu, Ş., & Ağır, H. (2011). Financial development and economic growth nexus in the MENA countries: Bootstrap panel granger causality analysis. *Economic modelling*, *28*(1-2), 685-693.

Khan, M. A. (2008). Financial development and economic growth in Pakistan: evidence based on autoregressive distributed lag (ARDL) approach. *South Asia Economic Journal*, *9*(2), 375-391.

Khan, M. A., Qayyum, A., Sheikh, S. A., & Siddique, O. (2005). Financial development and economic growth: The case of Pakistan [with Comments]. *The Pakistan development review*, 819-837.

Kim, J. I., & Lau, L. J. (1994). The sources of economic growth of the East Asian newly industrialized countries. *Journal of the Japanese and International Economies*, *8*(3), 235-271.

Kindleberger, C. P., & Kindleberger, C. P. (1978). *Government and international trade* (No. 129). International Finance Section, Department of Economics, Princeton University.

King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *The quarterly journal of economics*, *108*(3), 717-737.

Knight, M., Loayza, N., & Villanueva, D. (1993). Testing the neoclassical theory of economic growth: a panel data approach. *Staff papers*, *40*(3), 512-541.

Komal, R., & Abbas, F. (2015). Linking financial development, economic growth and energy consumption in Pakistan. *Renewable and Sustainable Energy Reviews*, *44*, 211-220.

Kuznets, P. W. (1971). *The Korean take-off* (No. 109). Center Discussion Paper.

Lange, H. F. (1946). The normal plasma protein values and their relative variations. *Acta Medica Scandinavica*, (Suppl. 176).

Lau, L. J., & Park, J. (2003, September). The sources of East Asian economic growth revisited. In *Conference on International and Development Economics in Honor Henry Y. Wan, Jr., Cornell University, Ithaca*.

LeBel, P. (2008). The role of creative innovation in economic growth: Some international comparisons. *Journal of Asian Economics*, *19*(4), 334-347.

Lee, H. H., & Tan, H. B. (2006). Technology transfer, FDI and economic growth in the ASEAN region. *Journal of the Asia Pacific Economy*, *11*(4), 394-410.

Levin, A., Lin, C. F., & Chu, C. S. J. (2002). Unit root tests in panel data: asymptotic and finite-sample properties. *Journal of econometrics*, *108*(1), 1-24.

Levine, R., Loayza, N., & Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics*, *46*(1), 31-77.

Liang, Q., & Jian-Zhou, T. (2006). Financial development and economic growth: Evidence from China. *China economic review*, *17*(4), 395-411.

Liang, Q., & Jian-Zhou, T. (2006). Financial development and economic growth: Evidence from China. *China economic review*, *17*(4), 395-411.

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics*, *22*(1), 3-42.

Luintel, K. B., & Khan, M. (1999). A quantitative reassessment of the finance–growth nexus: evidence from a multivariate VAR. *Journal of development economics*, *60*(2), 381-405.

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of management Review*, *21*(1), 135-172.

Maddala, G. S., & Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and statistics*, *61*(S1), 631-652.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The quarterly journal of economics*, *107*(2), 407-437.

Mansfield, E. (1972). Contribution of R&D to economic growth in the United States. *Science*, *175*(4021), 477-486.

Manu, L. P., Adjasi, C. K., Abor, J., & Harvey, S. K. (2011). Financial stability and economic growth: a cross-country study. *International Journal of Financial Services Management*, *5*(2), 121-138.

Marshall, A. (1890). " Some aspects of competition." The address of the president of section F--Economic Science and Statistics--of the British Association, at the Sixtiet Meeting, held at Leeds, in September, 1890. *Journal of the Royal Statistical Society*, *53*(4), 612-643.

McKinnon, R. I. (1992). Taxation, money, and credit, in a liberalizing socialist economy. *Economics of Planning*, *25*(1), 97-112.

Mehta, A. M., Qamruzzaman, M., Serfraz, A., & Ali, A. (2021). The role of remittances in financial development: Evidence from nonlinear ARDL and asymmetric causality. *The Journal of Asian Finance, Economics and Business*, *8*(3), 139-154.

Menyah, K., Nazlioglu, S., & Wolde-Rufael, Y. (2014). Financial development, trade openness and economic growth in African countries: New insights from a panel causality approach. *Economic Modelling*, *37*, 386-394.

Mhadhbi, K. (2014). New proxy of financial development and economic growth in medium-income countries: A bootstrap panel granger causality analysis. *American Journal of Applied Mathematics and Statistics*, *2*(4), 185-192.

Minsky, H. P. (1991). Financial crises: Systemic or idiosyncratic.

Nadiri, M. I. (1993). Innovations and technological spillovers.

Naeem, M. Z., & Sulehri, F. A. (2019). Water Resources and Agricultural Productivity in Pakistan: An Empirical Analysis. *Bulletin of Business and Economics (BBE)*, 8(1), 46-56.

Nagel, E. (1963). Assumptions in economic theory. *The American Economic Review*, *53*(2), 211-219.

Nelson, R. R., & Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *The American economic review*, *56*(1/2), 69-75.

Neusser, K., & Kugler, M. (1998). Manufacturing growth and financial development: evidence from OECD countries. *Review of economics and statistics*, *80*(4), 638-646.

Odhiambo, N. M. (2004). Is financial development still a spur to economic growth? A causal evidence from South Africa. *Savings and development*, 47-62.

Odhiambo, N. M. (2009). Energy consumption and economic growth nexus in Tanzania: An ARDL bounds testing approach. *Energy policy*, *37*(2), 617-622.

Okereke, S. F. (2015). *An econometric analysis of the impact of financial deepening on aggregate welfare in Nigeria* (Doctoral dissertation).

Osei, M. J., & Kim, J. (2020). Foreign direct investment and economic growth: Is more financial development better?. *Economic Modelling*, *93*, 154-161.

Osei, M. J., & Kim, J. (2020). Foreign direct investment and economic growth: Is more financial development better?. *Economic Modelling*, *93*, 154-161.

Ozturk, I. (2008). Financial development and economic growth: Evidence from Turkey. *Applied Econometrics and International Development*, *8*(1).

Pece, A. M., Simona, O. E. O., & Salisteanu, F. (2015). Innovation and economic growth: An empirical analysis for CEE countries. *Procedia Economics and Finance*, *26*, 461-467.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American statistical Association*, *94*(446), 621-634.

Petrariu, I. R., Bumbac, R., & Ciobanu, R. (2013). Innovation: a path to competitiveness and economic growth. The case of CEE countries. *Theoretical & Applied Economics*, *20*(5).

Petrariu, I. R., Bumbac, R., & Ciobanu, R. (2013). Innovation: a path to competitiveness and economic growth. The case of CEE countries. *Theoretical & Applied Economics*, *20*(5).

Porter, M. E. (1990). The competitive advonioge of notions. *Harvard business review*, *73*, 91.

Porter, M. E. (1996). Competitive advantage, agglomeration economies, and regional policy. *International regional science review*, *19*(1-2), 85-90.

Posner, M. V. (1961). International trade and technical change. *Oxford economic papers*, *13*(3), 323-341.

Pradhan, R. P., Mallik, G., & Bagchi, T. P. (2018). Information communication technology (ICT) infrastructure and economic growth: A causality evinced by cross-country panel data. *IIMB Management Review*, *30*(1), 91-103.

Raghupathi, V., & Raghupathi, W. (2019). Exploring science-and-technology-led innovation: a cross-country study. *Journal of Innovation and Entrepreneurship*, *8*(1), 1-45.

Ramadani, V., Gërguri, S., Rexhepi, G., & Abduli, S. (2013). Innovation and economic development: The case of FYR of Macedonia. *Journal of Balkan and Near Eastern Studies*, *15*(3), 324-345.

Ricardo, D. (1891). *Letters written by David Ricardo during a Tour on the Continent*. Privately printed.

Rioja, F., & Valev, N. (2004). Finance and the sources of growth at various stages of economic development. *Economic Inquiry*, *42*(1), 127-140.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of political economy*, *94*(5), 1002-1037.

Roubini, N., & Sala-i-Martin, X. (1992). Financial repression and economic growth. *Journal of development economics*, *39*(1), 5-30.

Rousseau, P. L., & Wachtel, P. (1998). Financial intermediation and economic performance: historical evidence from five industrialized countries. *Journal of money, credit and banking*, 657-678.

Rousseau, P. L., & Wachtel, P. (2000). Equity markets and growth: Cross-country evidence on timing and outcomes, 1980–1995. *Journal of Banking & Finance*, *24*(12), 1933-1957.

Sala-i-Martin, X. (2001). Comment on'growth empirics and reality,'by William A. Brock and Steven N. Durlauf.

Salas-Guerra, D., & Cesar, R. (2021). Impact of digital economic activity on regional economic growth: A Case study from northern Minas Gerais between 2009 To 2018. *arXiv preprint arXiv:2105.02849*.

Satti, S. L., Shahbaz, M., Mujahid, N., & Ali, A. (2013). Impact of Financial Development and Globalization on Inflation: The Role of Remittance and Economic Growth in Bangladesh.

Schumpeter, J. A. (1911). The Theory of Economic Development (Cambridge, MA: Harvard Uniyyrsity Press, 1911).

Schumpeter, J. A. (1939). *Business cycles* (Vol. 1, pp. 161-174). New York: Mcgraw-hill.

Şendeniz Yüncü, İ. (2007). Essays on financial development and economic growth.

Şentürk, I. &Ali, A. (2022). The Relationship between Institutional Quality and Welfare: Panel-SUR Analysis on BRICS-T Countries. *Journal of Policy Reserch*, 8(2).

Senturk, I. (2021). Aging and Employment: A Study on the Labor Force Participation Decision of the Elderly in Turkey. *Bulletin of Business and Economics*, 10(4).

Şentürk, İ., & Ali, A. (2021). Socioeconomic Determinants of Gender Specific Life Expectancy in Turkey: A Time Series Analysis. *Sosyoekonomi*, 29(49), 85-111.

Shahbaz, M., & Rahman, M. M. (2012). The dynamic of financial development, imports, foreign direct investment and economic growth: cointegration and causality analysis in Pakistan. *Global Business Review*, *13*(2), 201-219.

Shahbaz, M., Ahmed, N., & Ali, L. (2008). Stock market development and economic growth: ARDL causality in Pakistan. *International Research Journal of Finance and Economics*, *14*(1), 182-195.

Shan, J. (2005). Does financial development 'lead'economic growth? A vector auto-regression appraisal. *Applied Economics*, *37*(12), 1353-1367.

Shan, J. Z., Morris, A. G., & Sun, F. (2001). Financial development and economic growth: An egg-and-chicken problem?. *Review of international Economics*, *9*(3), 443-454.

Smith, A. (1776). An inquiry into the nature and causes of the wealth of nations: Volume One. London: printed for W. Strahan; and T. Cadell, 1776..

Solow, R. M. (1957). Technical change and the aggregate production function. *The review of Economics and Statistics*, 312-320.

Stevens, P., & Weale, M. (2004). Education and economic growth. *International handbook on the economics of education*, *27*, 205-311.

Sulehri, F. A. Rizwan, M., & Senturk, I. (2022). The Impact of Intangible Assets and Firm-Specific Factors on Cash Flows: An Empirical Analysis of Public Firms Listed on The Pakistan Stock Exchange. *Bulletin of Business and Economics*, 11(3).

Sulehri, F. A., & Ali, A. (2020). Impact of political uncertainty on pakistan stock exchange: An event study approach. *Journal of Advanced Studies in Finance,* 11(2), 194-207.

Sulehri, F. A., & Khan, J. (2020). The Effect Of Trade Openness On Inflation In Pakistan. *Bulletin of Business and Economics (BBE)*, 9(3), 135-140.

Sulehri, F. A., & Naeem, M. Z. (2018). The Role of Commercial Banks in Determining the Industrial Productivity in Pakistan: A Time Series Analysis. *Bulletin of Business and Economics (BBE)*, 7(4), 185-196.

Sulehri, F. A., & Sharif, S. (2022). The Impact of Firm Sustainability on Firm Growth: Evidence from USA. *Journal of Policy Research*, 8(2), 1-15.

Sulehri, F. A., Ahmed, U., & Alim, W. (2021). Black Economy, Financial Inclusion, Financial Liberalization Nexus: A Panel Analysis of Developing Countries. *Bulletin of Business and Economics (BBE)*, 10(3), 65-77.

Svirydzenka, K. (2016). *Introducing a new broad-based index of financial development*. International Monetary Fund.

Tahir, M., Jan, A. A., Shah, S. Q. A., Alam, M. B., Afridi, M. A., Tariq, Y. B., & Bashir, M. F. (2020). Foreign inflows and economic growth in Pakistan: Some new insights. *Journal of Chinese Economic and Foreign Trade Studies*.

Tidd, J. (2006). A review of innovation models. *Imperial College London*, *16*.

Tiwari, A. K., & Mutascu, M. (2011). Economic growth and FDI in Asia: A panel-data approach. *Economic analysis and policy*, *41*(2), 173-187.

Topel, R. (1999). Labor markets and economic growth. *Handbook of labor economics*, *3*, 2943-2984.

Tuna, K., Kayacan, E., & Bektaş, H. (2015). The relationship between research & development expenditures and economic growth: The case of Turkey. *Procedia-Social and Behavioral Sciences*, *195*, 501-507.

Usman, M., & Hammar, N. (2021). Dynamic relationship between technological innovations, financial development, renewable energy, and ecological footprint: fresh insights based on the STIRPAT model for Asia Pacific Economic Cooperation countries. *Environmental Science and Pollution Research*, *28*(12), 15519-15536.

Von Tunzelmann, G. N. (1995). *Technology and industrial progress: the foundations of economic growth*. Edward Elgar Publishing.

Wang, Y., & Liu, S. (2016). Education, human capital and economic growth: Empirical research on 55 countries and regions (1960-2009). *Theoretical Economics Letters*, *6*(02), 347.

Wolde-Rufael, Y. (2009). Re-examining the financial development and economic growth nexus in Kenya. *Economic Modelling*, *26*(6), 1140-1146.

Wong, P. K., Ho, Y. P., & Autio, E. (2005). Entrepreneurship, innovation and economic growth: Evidence from GEM data. *Small business economics*, *24*(3), 335-350.

Wood, A. (1993). Financial development and economic growth in Barbados: Causal evidence. *Savings and Development*, 379-390.

Xu, B. (2000). Multinational enterprises, technology diffusion, and host country productivity growth. *Journal of development economics*, *62*(2), 477-493.

Xu, L., & Zeng, D. (2021). When does the diverse partnership of R&D alliances promote new product development? The contingent effect of the knowledge base. *Technology in Society*, *65*, 101590.

Yang, C. H. (2006). Is innovation the story of Taiwan's economic growth?. *Journal of Asian Economics*, *17*(5), 867-878.

Yonezawa, Y., & Azeez, A. A. (2010). Financial systems and economic performance: a cross country analysis.

Zhang, Y. J., Liu, Z., Zhang, H., & Tan, T. D. (2014). The impact of economic growth, industrial structure and urbanization on carbon emission intensity in China. *Natural hazards*, *73*(2), 579-595.