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How do Globalization, Technological Change and Employment Impact Economic Growth in Developing Countries? Evidence from Panel Data Analysis

^a Fatima Saleem, ^b Fatima Farooq, ^c Imran Sharif Chaudhry, ^d Noreen Safdar

^a PhD M.phil Scholar, School of Economics, Bahauddin Zakariya University, Multan Pakistan: dua.1234567a@gmail.com

^b Assistant Professor, School of Economics, Bahauddin Zakariya University, Multan Pakistan: fatimafarooq@bzu.edu.pk

^c Professor of Economics, School of Economics, Bahauddin Zakariya University Multan, Pakistan: imran@bzu.edu.pk

^d Assistant Professor, Department of Economics, Women University Multan, Pakistan

Corresponding author's email address: fatimafarooq@bzu.edu.pk

ARTICLE DETAILS	ABSTRACT
History: Accepted 16 December 2018 Available online 31 December 2018	This study aims at exploring the impact of globalization, technology and employment on economic growth of developing economies. This study also observed the long-run, short-run and causality relationships between globalization, technological innovations, employment, and economic growth for 20 selected developing countries covering the data for period of 1991 to 2017. Since stationarity of variables is examined through ADF tests, Levin-Lin-Chu test, and IM-Pesaran-Shin test and resulted with mixed order of integration, Panel ARDL estimation techniques are employed to measure the long run effects of these variables on growth of selected economies. Dumitrescu-Hurlin panel Granger Causality test was applied for causality analysis. All variables have strong positive and significant relationship with growth. This study concluded that knowledge and research-based education have a key role in promoting long-run growth as evident from the 'New growth theory' of Romer. On the basis of these results, it is suggested that knowledge and research-based education should be promoted and export-oriented policies should also be encouraged to attain benefits of trade openness and globalization for accelerating economic growth on sustainable basis.
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1. Introduction

"Historically nothing has worked better than economic growth in enabling societies to improve the life chances of their members, including those at the very bottom." (Dani Rodrik, 2007).

Economic growth throughout the world has not been same for a long time. Some economies are

growing faster than others. Economists have anticipated that the slow-growing economies will sooner or later converge to the fast-growing economies. Economists are interested in the reasons and factors which cause different states to grow at dissimilar rates and to achieve diverse levels of wealth. This problem is particularly important today, since it was where the development economics of the 1940 was born. The historical record expresses a wide range of outcomes for sustained economic growth. Some countries (particularly in East Asia) have achieved very rapid rates of growth and have caught up with already wealthy countries while others mainly Sub-Saharan Africa have achieved little or no growth. To find reasons of these differences is always an important empirical and theoretical task because growth is not a means of ending, it is designed to serve individuals, promote development and to cut poverty even if the state is ruled by the king, their performance is judged based on prosperity (economic growth) and the employment situation of their subjects. According to several studies' employment, technology and globalization mainly affect the growth of economies. For example, Okun's rule of thumb labels the relationship between the rate of change in unemployment and the growth rate of GDP. According to Okun growth in real GDP growth rate, which is close to its potential, is usually necessary because of the increasing scale of work force and productivity levels, just to keep the unemployment rate stable. Thus, in order to reduce unemployment, the economy must grow at a rate higher than its potential (Arthur Okun, 1960s). Kiran, Subashini & Nagamani (2014) mentioned about growth and employment rate that economic growth is expected to result from an appropriate combination of employment growth and productivity growth. In most countries, there is a continuing problem of job shortages and unemployment.

Furthermore, first economists undoubtedly aware with the general concept that people and markets for all around the world were becoming more integrated over time. Though Adam Smith (1776) never used the word globalization, but it was a key theme in his book *Wealth of Nations*. His picture of economic development is the basic principle of market integration over time. As the division of labor has expanded output and the quest for specialization has expanded trade it gradually brought communities together around the world. According to Heckscher Ohlin (1919, Book: *International trade theory*) globalization ended the same factor prices in each country such as due to trade in goods and services, as well as capital flows, labor income will also become similar. This convergence may occur even in the absence of international immigration. Globalization must be beneficial to employees. At first glance, differences in wages between Bangladesh and the United States raised doubts about the validity of this argument but numerous empirical studies exposed that wage equalization in countries is considerably higher than the raw data suggests. Growth is needed to be built in an increasingly globalized world, offering new opportunities, as well as creating new challenges. Also new technologies not only provide the potential for "catching up" but also the possibility of "jumping", globalization makes possible the transfer of technology and increase in employment. The wide-ranging impact of globalization on all aspects of life has aroused great concern over nearly the past three decades.

Economists generally believe that the open economy is growing faster than others (Edwards, 1993) (Grossman & Helpman 1991). If openness does have a positive relationship with growth, then liberalization is a necessary condition for growth. Despite their early promises, recent experience shows that not all trade reforms are as successful as expected (Singh, 2010). Lucas (2000) provided a very useful reference point from the neoclassical point of view. He believed that, while the 20th century was marked by an increase in international income inequality, the 21st century would see this reversal. The United Nations even predicted that globalization may have the power to remove poverty in 21st century.

According to new classical school of thought economic growth can be promoted in the short term

through factor accumulation or more efficient use of factors which is feasibly possible by increase in globalization, but permanent growth can only be caused by technological innovation. Paul Romar (chief economist in world bank since feb,2018) and other followers of new growth theory declared that knowledge is root cause of economic growth and knowledge and ideas cannot be finite. Ideas leads to innovations which cause to a long run growth. Continuous economic growth has a positive influence on profits, level of employment, income which further improve living standards. In 2009 Janez Potocnik (European Science and Research commissioner since 2004) shared his views that technological innovation is very important factor for economy and growth. Countries that have worked in the field of technological progress grow rapidly in comparison to countries that paid less effort to technological expansion. Doris Lapple (2016) empirically tested the new growth theory on few developing economies for seeking the effects of technology on employment and concluded that increase in technology cause employment to increase (but adjustment takes time) in developing countries which leads to higher growth according to Okun's law.

From last 25 years there was an increasing trend in GDP growth of Argentina, Brazil, Ukraine, China, and many other developing economies. In Bangladesh, Indonesia, India, Malaysia and few other developing economies growth is continuous. Colombia, Ecuador, Iran and developed countries also have fluctuations in GDP growth rate. What are the reasons of these fluctuations in growth? Now the question is, to what extent factors (e.g. technology, employment) are affecting to each other specifically economic growth? Are these factors cause to decline in GDP growth rate of few developing economies? Few developing economies are growing faster and becoming wealthier than the others. To find out the reasons behind these differences in present time, it is needed to address the combined effects of technology, employment and globalization in developing economies. So, the present study is an attempt to cover these areas to investigate the mutual effects of globalization, technology and employment on GDP and can be helpful in suggesting the appropriate policies to developing economies based on their differences in growth.

2. Review of the Literature

Numerous studies have been analyzed the impact of employment, technological innovations and globalization on growth of any economy separately. Examination for earlier literature regarding to this study is as follows:

Barker et al. (2006) concluded in their study that general technological change alone seems doubtful to lead to decarbonization. It was suggested that if policies lift real carbon prices then extra investment from induced technological change will expect to lead more economic growth.

Borrego and Collado (2002) enquired the relationship between employment and innovation using data of Spain as evidence and concluded a strong positive impact on net employment formation. But adjustment and technology cost had been ignored in this research. Similarly, Jung et al. (2017) worked on employment, economic growth and factor-biased progress in technology and showed that factor-biased technological progress has a positive relationship with economic growth and indirect employment but negative with direct employment.

Samimi and Jenatabadi (2014) specified that middle and high-income countries took advantage of globalization while low-income economies do not gain from it. Policymakers should make policies for improving knowledge, level of educated workers and managerial for employing the new technology and to get more opportunities from globalization. Gurgul and Lach (2014) certifies that development of

globalization has strong positive impacts on GDP growth of CEE economies.

Grossman and Helpman (2015) also explored that trade improved the source distribution by replacing some less efficient domestic sellers with more efficient foreigners. Kilic (2015) observed the globalization in depth and found that economic growth levels of developing countries were positively affected by economic and political globalization while social globalization affected economic growth inversely.

On the contrary, Napoles (2004) exposed that positive outcome of exports on direct and indirect employment is not as important as that of domestic production. Moreover, Dhont and Heylen (2009) projected that individuals may gain from policies that increase productive government expenditures, financed by a cut in of employment immigration. In 2010 Merikull declared the same factor that overall innovation has strong positive and significant effect on employment growth at firm level. But at industry level product innovation positively and process innovation negatively affect the employment growth. Therefore, the net effect on industry's job creation is insignificant or zero. Innovation has also no effect on employment in high technology sector.

Adak (2015) and Gabriel et al. (2016) stated the significant positive relationship between technological progress and economic growth in Turkey. Hwang and Shin (2017) suggested that investment was required in ICT tangible and ICT intangible capital to increase economic growth. Latif et al (2018) and Bekhet (2018) also analyzed a positive relationship between sustainable growth with technological progress. According to researcher relevant and well-planned policies for technological progress can be helping hand for sustainable growth. The current study is designed to highlight the effects of globalization, technological change and employment on economic growth in developing economies.

3. Data, Models and Methodology

3.1 Data Description

This research study based on examination of developing countries using panel data set. Selection of good variables and data for study depends on main objectives and sample of study. Secondary data is collected for twenty-seven years from 1991 to 2017 and for 20 countries selected as sample including lower middle-income countries and middle-income countries. (See Appendix A and Appendix B for countries' list and data sources.)

3.2 Methodological Description

Methodology description is covering the methods & principles associated with this study and instrumental design of study. To reach the conclusion, the study drives its methodology incorporating variables application.

ARDL (autoregressive distributed lag) technique is applied to measure impacts of short and long run. Technique is selected on base of stationarity of variables. The term autoregressive indicates that with y_t explained by x_t , it also explained by y_{t-1} (its own lag). General equation of ARDL is given below:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \dots + \beta_p y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + \dots + \alpha_q x_{t-n} + \mu_t$$

m and n used for lag length and μ_t error term.

To check stationarity of data panel unit root tests Im-Pasaran-Shin and Levin-Lin-Chu unit root

tests are applied. To analyze the cause and effect of variables granger causality test, Dumitrescu Hurlin Panel causality has been applied. Linear form of this causality test is

$$Y_{it} = \alpha_i + \sum_{L=1}^L Y_{i,t-L}^L + \sum_{L=1}^L \beta^L X_{i,t-L} + \mu_{it}$$

“i” represent the cross sections, “t” represents the time period.

3.3 Model Specification

The model used in this study for causality across gross domestic production (GDP, used to measure growth), patent applications residents (PATR), patent applications non-residents (PATN), economic globalization index (ECGI), gross capital formation (GCF) and employment to population ratio (EMP) modelled as

$$GDP_{it} = f(GFC_{it}, EMP_{it}, ECGI_{it}, PATR_{it}, PATN_{it})$$

Log-log functional form is used to estimate model here L with identity of all variables in model is showing the log of that variables:

$$LGDP_{it} = \beta_0 + \beta_1 LGCF_{it} + \beta_2 LEMP_{it} + \beta_3 ECGI_{it} + \beta_4 LPATR_{it} + \beta_5 LPATN_{it} + \mu$$

Where i (i=1,2,3, 4.... N) indicates cross sections and t (t=1,2,3, 4.... T) represents the time and μ is error term. GDP is dependent variable used as proxy of growth and patent applications (residents & non-residents) are used as proxy of technological innovations.

4. Results

Results for ADF test of unit root are showing that variables have mixed order of integration:

4.1 ADF unit root analysis for test:

Variables	Test for unit root	Include in test equation	Statistics	Probability	Remarks
LEMP	level	Individual intercept	-1.63553	0.9894	I(1)
	level	Individual intercept and trend	-0.68839	0.0000	—
	1 st difference	Individual intercept	-13.1281	0.0000	—
	1 st difference	Individual intercept and trend	-10.8860	0.0000	—
LGCF	level	Individual intercept	-0.13440	0.4465	—
	level	Individual intercept and trend	0.00039	0.5002	—
	1 st difference	Individual intercept	-14.6159	0.0000	I(1)
	1 st difference	Individual intercept and trend	-11.8899	0.0000	—
LGDP	level	Individual intercept	0.73299	0.7682	—
	level	Individual intercept and trend	-0.32736	0.3717	—

LECGI	1 st difference	Individual intercept	-15.8689	0.0000	I(1)
	1 st difference	Individual intercept and trend	-13.9990	0.0000	–
	level	Individual intercept	-2.48075	0.0006	I(o)
	level	Individual intercept and trend	1.48455	0.9321	–
	1 st difference	Individual intercept	-16.8568	0.0000	–
	1 st difference	Individual intercept and trend	-15.4257	0.0000	–
LPATN	level	Individual intercept	-5.22896	0.0000	I(o)
	level	Individual intercept and trend	-3.24507	0.0006	–
	1 st difference	Individual intercept	-15.6816	0.0000	–
	1 st difference	Individual intercept and trend	-13.7386	0.0000	–
	level	Individual intercept	0.38031	0.6481	–
	level	Individual intercept and trend	-3.10819	0.0009	I(o)
LPATR	1 st difference	Individual intercept	-18.8077	0.0000	–
	1 st difference	Individual intercept and trend	-16.5046	0.0000	–

Source: authors' calculations using EViews 9

According test results probability values of LECGI, LPATN and LPATR are 0.0006, 0.0000, and 0.0009 respectively showing stationary at level. LGCF, LGDP, and LEMP have probabilities values more than 5% these are not stationary at 1st difference with high significance.

4.2 Causality analysis

GDP and GCF has bidirectional homogenous causality in selected developing economies showing that in which economies GDP will grow' capital formation would be generated.

Variables	Description (at 5% significance level)
LGDP → LGCF	Bidirectional homogeneous causality
LGDP → LPATN	Uni-directional causality
LGDP → LPATR	Bidirectional homogeneous causality
LGDP → LEMP	Bidirectional homogeneous causality
LGDP → LECGI	Uni-directional causality
LECGI → LEMP	Uni-directional causality
LGCF → LEMP	Bidirectional homogeneous causality
LPATR → LEMP	Bidirectional homogeneous causality
LPATR → LECGI	Uni-directional causality

And if there will be increase in capital formation investment will be more and domestic production cause to increase in growth. EMP and GDP also have bidirectional causality showing that if employment will increase, then more demand for consumer products will cause to increase in production. And if GDP will increase in a developing economy more labour force need to hire, it leads to job creation.

In same way GDP growth will cause to increase in exports and fall in imports because consumer's demand fulfilled by domestic production as we see economic globalization have bi-directional causality with GDP that increase in trade openness and globalization will cause to GDP it may be negative or positive depends on increase in imports or exports. Rise in GDP causes the economy to be stronger for exports, as a result, trade openness will increase which leads to rise in economic globalization (exports and imports of goods and services). Patent applications and GCF has unidirectional relationship. Showing that patent applications does not cause to growth in capital formation because applications are based on ideas and knowledge not on stock of capital. But capital formation effects the technology in such a way that increase in capital formation leads to increase in investment in technological innovation (R&D).

4.3 ARDL Estimation Results

Maximum lag length is set at 2 by using Akaike info Criterion, model based on ARDL (2,2,2,2,2,2) carried out period 1991 to 2017. Except PATN all variables have statistically significant probability values and null hypothesis are rejected because significance showing LGCF, LEMP, LECGI, LPAR have strong relationships with LGDP. Log of all variables showing the percentage dependency of regressors on GDP. Coefficient of COINTEQ01 called 'cointegrated error correction coefficient' which is also significant representing short run association with long run. ARDL estimations presented in table here: -

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
LGCF	0.800	0.011	74.088	0.000
LPATN	-0.021	0.016	-1.306	0.193
LPATR	0.025	0.010	2.556	0.011
LEMP	0.193	0.085	2.280	0.000
LECGI	0.318	0.029	11.083	0.000
Short Run Equation				
COINTEQ01	-0.310	0.083	-3.728	0.000
D(LGDP(-1))	0.077	0.073	1.065	0.288
D(LGCF)	0.354	0.073	4.820	0.000
D(LGCF(-1))	-0.056	0.054	-1.029	0.304
D(LPATN)	0.000	0.031	-0.008	0.994
D(LPATN(-1))	0.035	0.022	1.551	0.122
D(LPATR)	-0.011	0.018	-0.633	0.528
D(LPATR(-1))	-0.001	0.023	-0.037	0.971
D(LEMP)	-0.606	0.284	-2.137	0.034
D(LEMP(-1))	-0.450	0.326	-1.378	0.170
D(LECGI)	-0.197	0.129	-1.533	0.127
D(LECGI(-1))	-0.025	0.082	-0.307	0.759
C	0.606	0.164	3.683	0.000

Sources: Authors' own calculation based on the data taken from the sources mentioned above.

It is showing that LPATN is not significant, there is 19.3% chances that estimation between LAPT and GDP is not exact. LPATR is significant at 5% and LGCF, LEMP and LECGI are highly significant showing that coefficients are declaring exact relationship. Sum squared residual is 0.5620 indicating that 0.56% variations of dependent variable GDP are not explained by this model according this criterion the model is perfect. Standard error of regression 0.0489 is showing that GDP predicted values are only at 4% distance from regression line. Akaike info criterion is -2.78093 and log likelihood is 960.2312 in this

model. In both short run and long run standard errors are between zero and one.

By putting coefficient values of coefficients in long run ARDL equation: -

$$LGDPit = (0.800)LGCFit + (0.193)LEMPit + (0.318)LECGlit + (0.025)LPATRit + (-0.021)LPATNit$$

All coefficients are showing percentage relationship because log of both dependent and independent variable has been taken for estimation. LGCF coefficient is +0.800 with high significance and has a positive sign indicating that 1% increase in gross capital formation will cause 80% increase in gross domestic production of selected developing economies. Increase capital formation cause to increase in investment and gross domestic production which leads to economic growth. Harrod Domar (1940's) in his growth theory claimed that growth is positively determined by more capital and savings. Solow analysis (1957) showed physical capital growth contributes to production growth. The endogenous growth theory established by Romer (1986), Lucas (1988), Barro (1990), and Romar (1990) re-evaluated this statement by accumulating other factors as human capital, R&D which quicken gross capital formation which leads to growth of economies. LEMP coefficient value is +0.193 associated with high significance and positive sign indicating that with 1% rise in employment rate, gross domestic production for selected economies will grow by 19.3%. Increase will employment cause to increase in consumer spending it create more capital for investors, they invest more in production in result GDP increases (Jonathan Lister 2003). Arthur Okun (1960s) talked about employment and growth that if unemployment reduces by 1% (or employment increases at 1%) GDP will grow at 4%.

LECGI coefficient is +31.8% with high significance showing highly positive multiplier effect that 1% increase in globalization will cause 31.8% increase in GDP of developing economies. Rise in globalization would increase the competition and efficiency of producing goods and services, will also increase the foreign direct investment and transfer of technology this would increase the efficiency of production and GDP rises (Justin Kuepper, 2018 & Fairouz Hamdi, 2015). Different studies have different views about it according literature few accepted and evaluated and justified a positive effect on growth and few declared that it negatively affects the growth because it contains risks. But according this study globalization positively affect the growth of economy. Adam smith (1776), Ricardo (1817) Heckscher Ohlin (1919) and others agreed that globalization increases the efficiency, welfare, and growth of economies. Patent applications are cause to technological innovations. LPATR coefficient is +0.0254 with 5% significance presenting that 1% rise in residents patent applications will root to rise GDP by 2.5% in selected countries. Increase in technology would increase the capital quality and production (Elena Kvochko, 2013). Solow (1956), Romar (1990) accepted in their established theories that long run growth is possible with technological progress. Patent applications residents causes to increase 2% GDP with 1% increase in resident's applications but here significance to accepting this result is 19.3% that is very high, so we reject this alternative hypothesis and not much sure about result.

In short run: cointegration between long run and short exist. Coefficient of error correction cointegration is -0.310 with significance 0.0004% and a negative sign showing that speed of adjustment is 31% yearly at this speed short run dynamics of selected economies converge to long run equilibrium track in model. In short run estimation lagged variables have coefficients less than zero indicating that GDP, employment rate, globalization index, and patent applications are slowly adjusting to future values. Gross capital formation also has strong positive effects to GDP in short run.

Note: GDP variable used in this study as a proxy for growth. So, increase in GDP represents the increase in growth (in interpretation of model).

5. Findings, discussions and Policy Recommendations

Technological progress, globalization as well as economic globalization and employment are closely linked and have great effects on growth of an economy. Numerous studies have been done found positive or negative impacts of globalization on growth of an economy. Despite great volume of research, it has not been conducted to test combine association across globalization, technological change, employment, and growth in developing countries. Present research study is a try to examine causal relationship among all these for 20 developing economies over the period of 1991 to 2017. To realize the directions and estimate the relationships between them panel ARDL approach with double log model is used. Main purpose for this empirical analysis is to examine the trend and effects of declining growth in developing countries and the reasons associated with this decline. Patent applications used as proxy variable for technological innovations and GDP is dependent variable used to measure growth. Main findings of this study are technological innovations, employment, globalization, economic globalization, and trade openness have strong positive and statistically significant effect on GDP growth of selected developing economies.

Trends of data are showing that when there was increase in technological innovations (patent applications) long run growth of economies were rising but when it moved to decline the growth process was also going to slow. Specifically, in China, Ukraine, Brazil, and India, they utilize more resources on innovations, growth of these economies is faster. Moreover, innovations are approached by focusing on strategies about investment in R&D, China and Malaysia furnished example for it. As observed in Indonesia reduction in employment growth have negative impact on GDP growth. Moreover, Malaysia (poorest socioeconomic class) did investment in education and R&D which makes it able to create job opportunities and job training, in result undeniably, Malaysia experienced a rapid economic growth. Globalization in all economies is rising but collected data is showing that globalization has weaker relationship with employment but has a stronger with GDP growth. Globalization provide opportunities to workers that they can move all around the world to avail better opportunities, this interaction of economies encourages competition, efficient use of capital and specialization (but trade openness should be a trend to increase in exports rather than imports because dependency reduce the focus and energy to produce imported goods domestically). To put in a nut shell, it is concluded that technological progress is a key driver to growth for developing economies and solutions to economic problems like poverty and lower production as observed in analysis. Following step should be taken for the rapid growth of developing economies: to increase the level of knowledge, quality of education should be focused instead of only quantity, and research-based education should also be promoted for which a platform for youth research activities should be established. Investment in R&D sector should be promoted by giving grants to innovative activities. Exports policies should be focused to promote exports for attaining fully benefits of globalization and trade openness.

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APPENDIX A

Selected countries list is below:-

Sr. #	Country name	Sr. #	Country name	Sr. #	Country name	Sr. #	Country name
1	Argentina	6	Colombia	11	Ukraine	16	Philippines
2	Bangladesh	7	Ecuador	12	Mexico	17	Romania
3	Brazil	8	Indonesia	13	Malaysia	18	Thailand
4	Bulgaria	9	India	14	Pakistan	19	Turkey
5	China	10	Iran	15	Peru	20	South Africa

APPENDIX B

Description of data sources shown in table below: -

3.1.1. Data and source description

Variables	symbols	Description	Source
Gross domestic production	GDP	Measured in US\$ (a traditional and international measure)	World Development Indicators, World Bank
Gross capital formation	GCF	Measured in US\$ (a traditional and international measure)	World Development Indicators, World Bank
Employment to pop ratio	EMPR	Employed labor force total and % of employed population to total population	World Development Indicators, World Bank
Patent applications, residents	PATR	Number of total resident's applications filed at regional intellectual property offices	WIPO IP Statistics
Patent applications, non-residents	PATN	Number of total non-resident's applications filed at regional intellectual property offices	WIPO IP Statistics
Economic globalization index	ECGI	Index: a smaller sample that represents the whole, gives weight to a large number to measure easily	KOF Globalization index, KOF Swiss Economics Institute

Source: authors' own work