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ROLE OF TECHNOLOGY IN VALUE CREATION.

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Abstract:

Technology is considered as a wheel of change all over the world and the countries are competing in technology creation and its adaptation in order to sustain their competitiveness. This study is conducted to analyze the role of technology in value creation and value enhancement in Pakistan. In order to study the adoption of technology in different sectors of Pakistan's economy during the period of 1985-2028 GDP growth was taken as the dependent variable while large manufacturing sector, labour force, health, education and exports were selected as independent variables.' The ARDL and Error Correction Models were applied to estimate long run and short run relationship between independent and dependent variables. The analysis found that there is positive and significant relationship between independent and dependent variables. The study, therefore, suggests that it is an urgent need to allocate sufficient funds for research and development and introduction of technology in every sector of economy for attaining rapid economic growth and sustainable development.

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1. INTRODUCTION:

1.1. Background of study:

Economic value is a process of evaluation of assets and profits produced currently or in future. To compute the benefits from the yields or service provided by an economic agent (Entrepreneur). Therefore, economic value is the amount a consumer is ready to pay for a product or a service market. The innovations are considered as the key source of economic growth. Fast economic growth can be attained through innovations in all sectors of the economy. Not only in the developed and developing countries. Innovation is the creation of novel thoughts and their commercialization by means of innovative work (delivering expanding advances), the persistent improvement of advances (where they regularly become more affordable), and the dispersion of advances in industry or in society. Innovation has influenced the economy through direct job creation, commitment to GDP development, arrangement of new administrations and enterprises, labor force alteration and business modernization. The utilization of innovation has been connected to commercial center change, improved expectations for everyday comforts and more solid worldwide exchange. Financial development is an increment in the measure of products and ventures created by utilizing the accessible assets in a country during fixed timeframe. Total national output (GDP) is equivalent to all goods and services produced in a year in a country. Pakistan's nominal GDP ranked 25th and 41st in purchasing power parity as per data released in 2017. The value of Gross Domestic Product (GDP) of Pakistan was U$ 283.0 billion in 2017. The GDP growth rate was 5.4 in 2017. The GDP estimation of Pakistan addresses 0.44 percent

of the world economy. Pakistan's average GDP growth was around 4.91% from 1952 to 2016. It was high 10.22% in 1954 and very low 1.8% in 1952

1.2 Technological development in Pakistan

In Pakistan technology has significant effect on its economy through innovations and improvements in IT, telecommunication, manufacturing and other sectors. Advancement of technology, growth of economy and gross margins reflects significant relationship with the measurement of productivity and GDP. Fast emergence speed of descriptive products, models of business, transformation of digital technology in society and innovative business brought about changes in the economy of Pakistan. Pakistan government spend 4.6 billion on IT projects in the fiscal year 2012-2013. In Pakistan allocation of funds for development of science and technology was less than 1% of the total GDP which was very low as compared to other regional countries. Information technology has brought significant impact on the industrial sector of Pakistan in the recent years. IT exports in the period of 2016 to 2017 were around $3.3 billion which were expected to grow to $6 billion in next year. The rate of software development was 17 %, while adoption of technology in the marketing was grown to 15%. Similarly, technology adoption in financial services was 13%, in consumer goods technology was 9% and in e-commerce and professional services was 8%, internet hardware was 7%, media and healthcare were 4% respectively, and technology adoption in the non-profitable organization was only 3% in Pakistan.

1.3 Main research problem

The main objective of this study is to determine the impact of technological innovations on the economy of Pakistan during 1985-2028 period. Pakistan's population has exceeded 220 million and the ratio of working age population is more than 40%. Low literacy rate, lack of skill and low job opportunities, high poverty level are the main problems of Pakistan and these problems can be solved through technical education, training and skill development. This study has conducted to explore the effects of adoption of new technology on Pakistan's economy.

1.4 Objective of study

The objectives of this study are stated as under: -

1. To study the causes of backwardness and low productivity in Pakistan.
2. To determine the positive effects of introduction of technology in different sectors of Pakistan's economy.
3. To examine whether Pakistan's business environment is conducive for creativity and innovations.
4. To assess the impact of innovation in different sectors of economy and overall output.

1.5 Scope of Study

This scope of this study is very large because it deals with the impact of innovations on productivity. If the economy revolutionizes by adopting latest technology it will have following positive effects: -

- Provide jobs to the people
- Reduce poverty level in Pakistan.
- Increase level of investment.
- Resolve existing energy crisis.

- Enhance the demand of goods and services in Pakistan.
- Earn valuable foreign exchange through exports.
- Improvements in Research and development activities in Pakistan.

2. Literature review:

Jafarieh (2001) conducted research on "Innovation Transfer to developing countries”". His research focused on the fundamental financial qualities of nations engaged in the development of innovation. He analyzed vital factors responsible for the development of a country. He was of the view that quick industrialization and effective innovations are fundamental requirement for economic growth. Mehmood and Siddique (2001) analyzed the "State of Technology and Productivity in Pakistan's Manufacturing sector. They studied the research and development activities in Pakistan and adoption of technology and introduction of technology in business firms. They contended that innovations and research and development activities enhance efficiency and intensity of development. Their findings show that introduction of technology and innovation accelerate the process of development in business organization. They concluded that technology adoption enhances the skill of employees and quality of products. Amjad (2006) investigated the factors hampering Pakistan’s becoming a knowledge economy. He emphasized that no country can make progress on the basis of traditional methods of production. He urged to adopt latest technology in all sectors of the economy to boost productivity and growth. He disclosed that information technology has given central place in Pakistan’s Medium term development framework, 2005-10 and 2030. Gruber (2010) examined "Mobile Telecommunication and its Impact on Economic Development" in

developed and under-developed countries. He stated that introduction of information technology has huge effect on GDP growth and profitability of business organizations. The profitability of business firms depends on the degree of dissemination of innovations. The high rate of return on investment also boosts expansion of economic activities and job creation. He maintained that the developing economies have sufficient potential for realization of efficiency and accumulation of knowledge to move towards knowledge organizations. Driouchi (2015) analyzed "New Health Technologies and Health Workforce in Developing Economies" expresses that meaning of human wellbeing assets concerning current and future pattern of well-being. Talented work is needed for new innovations in well-being area. The focus of this study is on less talented work in non-industrial nations is the fundamental obstacle in selection of new innovation. In the event that the worldwide well-being framework system is accomplished by developing innovative capabilities. Ndesaulwa, (2016) investigated "The Impact of Technology and Innovation in Developing Countries empirically. He also studied the importance of innovations and advancement of technologies in economic development of developing countries. He emphasized that technologically advanced nations must help those nations which are technologically backward due to having low quality of human capital. The utilization of innovations and technologies in agro-based nations can enhance the production of different crops and reduce level of poverty and unemployment. He concluded that mechanical advancement and innovative process brings revolution in the economically backward economies. Lundquist, et al. (2017) probed into the causes of long run growth process

and transformation of the countries into knowledge economies. They also investigated financial development and growth of financial institutions in the long run. They argued that the development of innovations and adoption of technology are the basic requirement for financial development and change in way of doing business. This study is related to Swedish economy and covered a period from 1985 to 2018. The authors have concluded that adoption of innovations by business organizations have brought improvement in efficiency and profitability.

3. 3. Theoretical foundation:

In this section we will briefly discuss economic theories which are related to Technology and economic growth in order to understand the impact of technology on economic growth.

3.3.1 Cobb-Douglas production function:

The most prominent production function is the Cobb-Douglas Production function. Professor Paul Douglas with his colleague Cobb after empirical observations inferred its properties in mathematical form. Douglas had drawn a graph of total labor force, capital stock and GNP for the manufacturing industries of USA for a period of 1899-1922. From this analysis it was revealed that the difference between log of capital and log of GNP was constantly greater three times than from the log of labor and log of GNP. This production function is engraved in the following form.

$$\mathbf{Q_t = T_t\, K_t^{\alpha}\, L_t^{\beta}}$$

Q = Real output

T = Index of Technology

K = Index of Capital Stock in constant prices

L = Index of labor time

The steady state α (0≤α≥1) measures the versatility of capital when work supply is consistent and steady β measures the flexibility of work when capital stock is steady. When there is a 1 percent expansion of work and capital expands then yield additionally increment by (α+β) one percent. It will be increasing returns to scale when the amount of α and β is more noteworthy than one and when short of what one it will be decreasing returns to scale, equivalent to one addresses the constant returns scale. It is expected that the adjustment of innovation is resolved endogenously and free of supply factor change. It is likewise accepted that factor, power of creation and specialized advancement, are not influenced. The wellspring of yield development is recognized by the condition. Taking the logarithms of the factors and separating them regarding time that delivers the accompanying estimate:

$$\log Q = \log T + \log \alpha k + \log \beta L$$

The log Q is growth rate of output, log T is the growth rate technical progress, log is the growth rate of labor and α and β are the partial elasticity of output with respect to labor and capital and all are measured over time period. Equation states about that the growth rate of output constructed from growth rate of total productivity and growth rate of capital shown by α and growth rate of β. The values of log Q, log T, log K, log L are taken by three source of growth rate of output. Suppose that the value of log Q is 10, value of log K is 5 and log L is 3 and value of α is 0.25 and β is 0.75. The capital to output growth contribution is (0.25 .5)/10 that is 12.5% and contribution of

labor to output growth is (0.75. 3)/10 which is 22.5%. The technical progress contribution is 65%. There is no contribution from increasing returns to scale and the sum of α and β (0.25+0.75=1). The labor growth rate is constrained by population growth rate. The growth rate of labor force is higher 2% per anum for industrialized countries even in the condition of migration.

3.3. 2 Solow-Swan Model

Robert Solow and developed a growth model. It is a Neo-classical long run model. It is also known as Solow-Swan model which explain long run growth, growth of labor population, increase in productivity due to technical advancement and capital formation. The Neo-classical production function seems to be rooted type of Cobb-Douglas type production function.

Solow-Swan model assumes that:

- There is no government intervention.
- There is a single good production.
- Labor (L) and capital (K) are only two factors of production.

Solow model specify connection between inputs that are lab our and capital and yield which are labor and products. To extend the productive abilities of society the Solow model can be modified to incorporate exogenous variable technology over the period of time. In Solow model capital and labor are represented by K and L. Total output denoted by Y.

$$Y = F(K, L)$$

Production function can be written as:

$$Y = F(K, L \times E)$$

Where efficiency of labor is E,

Labor efficiency due to adoption of technology and latest method of production. The expression L×E represent the effective numbers of workers. L represents the number of actual workers and E represents efficiency per worker. The new production function represents both total output and capital and labor efficiency. The assumption of technical improvement shows that the growth of labor efficiency is at constant rate that is g = 0.02 which means that labor efficiency grows at 2% per Anum and output also grows by 2%. This type of technical improvement is called augmenting labor and g is called labor augmenting technical progress. The labor grows at n rate and labor efficiency grows at g rate then effective numbers of workers at (n+g). Because of labor augmented model it is taken as the population growth rate model the effective numbers of workers are increased by the technical progress. We viewed the economy as amounts per specialist without specialized advancement or technical progress. Presently, we break down output per work into two parts:

Let take $k = K/(L\times E)$ as capital per effective worker

$Y = Y/(L\times E)$ as output per effective worker

Now we can write it as

$$Y = f(k)$$

Our analysis of economy takes the form in the following equation:

$$\Delta k = s f(k) - (\delta + n + g) k$$

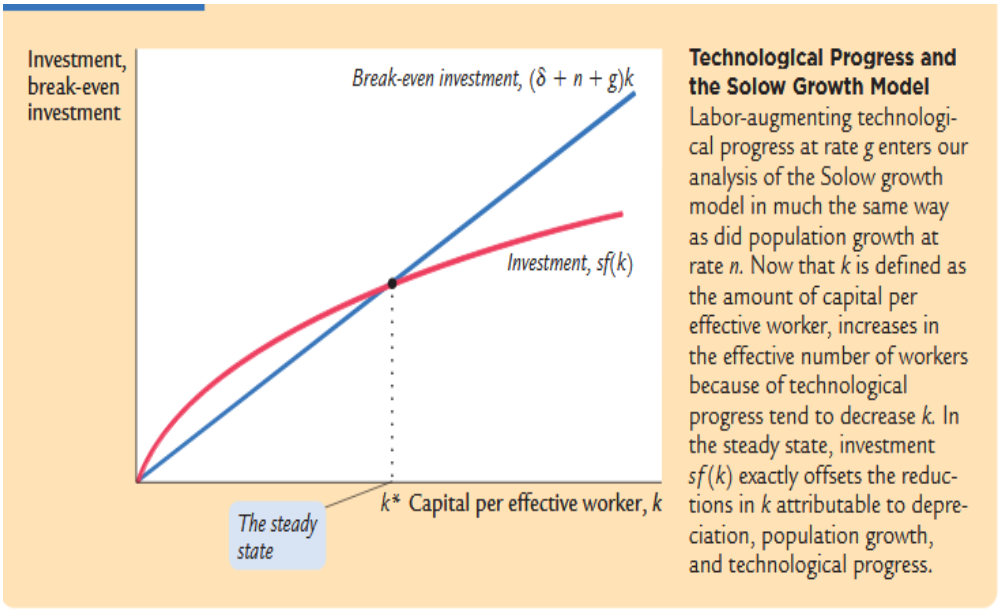
Capital change Δk equals to the $s f(k)$ and minus the breakeven investment $(\delta + n + g) k$.

k = K / (L × E) three times break even investment is included. Capital k is constant. δk is taken as depreciation of capital.

nk is a capital provided for new workers.

gk is amount of capital provided for new 'effective worker' produced due to technology. This process is shown in Figure 3.1.

Fig 3.1: Labor augmenting technological progress



Source: Macroeconomics by Gregory Mankiw

The figure portrayed that consistent steady state doesn't influence by the technological progress The capital k per effective worker and output per effective worker are constant at k* steady state level. The conceptual model developed on the basis of the above theories sketched in Figure 3.2: -

Fig 3.2: Conceptual Model

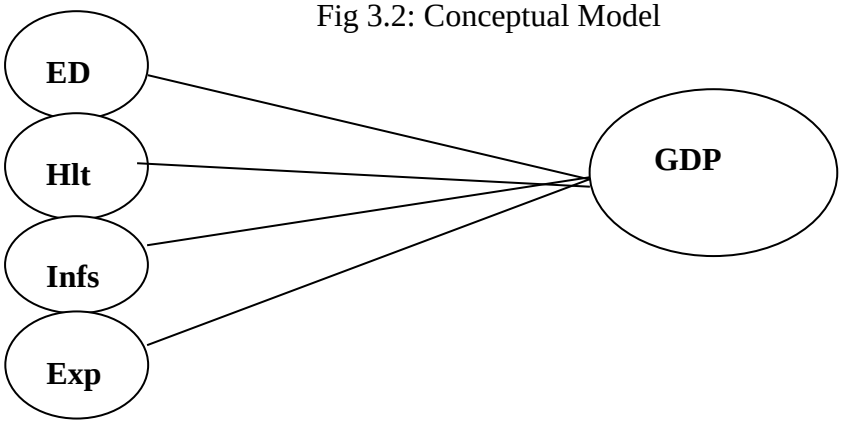


Figure 3.2 shows that the gross domestic product (GDP), which is dependent variable is affected by the health, education, exports and infrastructure, which are independent variable and these independent variables play a crucial role in determining GDP growth in the long run.

4. Research Methodology

4.1 Nature of the Study

This research study is based on time series data and data which is collected from World Development indicators, Pakistan Economic Survey, Hand book of statistics, and Pakistan Statistical year book (2018). It is a quantitative study in which quantitative methods are used to analyze the data.

4.2 Selected Variables:

The variables of this study and their expected sign ae shown in Table 1.

Table 4.1: Variable description

	Variables	Description
1	**Dependent variables**	-
	GDP	Gross domestic product

2	**Independent variable**	-
2.1	ED	Education
2.2	HLT	Health
2.3	INFR	Infrastructure
2.4	EXP	Export

4:3 Research Hypothesis

The hypotheses of this study are given below: -.

H_0 = Health, education, export and infrastructure have no significant impact on the economic value of technology towards GDP.

H_1 = Health, education, export and infrastructure have significant impact on the economic value of technology towards GDP.

4.3. Specification of Model:

For solid outcomes, reliable data is vital. We utilized time series data from 1985-2018 to determine the relationship between variables. We selected GDP as dependent variable while independent variables included in the model are: Large Scale manufacturing, Labor, Health, Exports and education (Edu). The model of this study is shown in the following general equation: -

Y (GDP) = LS Manu + Labor + Health + Exports +Edu.

Now the model is shown in mathematical equation

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu t$$

Where,

(y) = Gross Domestic Product

(X_1) = Large Scale Manufacturing sector

(X_2) = Labour force

(X_3) = Health

(X_4) = Exports

(X_5) = Education

μ_t = Error term

4.4 Analytical techniques:

For the analysis of the data, we used following statistical techniques.

- Descriptive statistics
- ADF test for checking stationarity among the variables.
- ARDL Model and Bound test for the determination of long run relationship between selected variables.
- Error Correction Model for checking short run relationship between selected variables.

5. Results and discussion

5.1 Descriptive Statistics

The descriptive statistics of variables containing means, median, minimum, maximum, standard deviation, skewness, Kurtosis, etc, are shown in Table 5.1.

Table 5.1: Descriptive Statistics:

	In(GPD)	In(Edu)	In(Exports)	In(Labour)	In(LS_Manu)	In(Health)
Mean	15.61624	171131	9.265091	4.217650	5.039055	10.16113
Median	15.58277	003761	9.123479	4.252344	4.967726	10.12008
Maximum	16.29039	346147	0.13102	4.284138	5.601750	12.06345
Minimum	14.84530	868599	.825685	3.962222	4.605170	8.123297
Std. Dev	0.431212	828446	0.669481	0.078931	0.326451	1.102205
Skewness	0.102073	157916	0.301670	1.903662	0.409131	0.001543

Kurtosis	1.816254	514020	2.082634	5.851594	1.764414	1.924491
JarqueBera	2.044151	269506	.707906	32.05534	3.111317	1.638700
Probability	0.359847	195001	0.425729	0.000000	0.211050	0.440718

Sources: Based on Authors' calculations

Table 5.1 shows the average of GDP, ln (GDP) 15.61624 with S.D of 0.431212, normal average of ln (Edu) 8.171131 having a S.D of 0.828446, the normal average of ln(Exports) is 9.265091 which is connected with standard deviation of 0.669481, normal average of ln (Labour) is 4.217650 which is connected with standard deviation of 0.078931, normal average of ln(LS Manu) is 5.039059 which is connected with standard deviation of 0.324651, normal average of ln(Health) is 10.16113 which is connected with S.D of 1.102205. Negative skewness existed between health, export and labour, yet certainly positive skewness between education and large-scale manufacturing. Kurtosis measurement of the factors depicts that export and lab our are leptokurtic (high peak and long tailed) and different values of variables show platykurtic (lower peak and short tailed). A Jarque-Bera test displays that export and labour residuals are not distributed normally yet other different values of variables are quite distributed normally.

2.2 ADF Unit Root Test:

A unit root test is used to check whether a time series variable is stationary or non-stationary. The null hypothesis is defined as the existence of a unit root and the alternative hypothesis is whether stationarity, trend stationarity or stable root depending on the test used. So many tests have been introduced to check the presence of Unit root but Dickey and Fuller is generally used to check the Unit Root among variables. The results of unit root tests are shown in Table 5.2

Table 5.2: Results of Unit Root Test

Variables	Augmented Dickey Fuller Test (at 5%)	Augmented Dickey Fuller Test (at 1st difference)
GDP	-3.900654	0.0054
Lnedu	-6.231441	0.0000
Lnexport	-4.967243	0.0003
Lnlabour	-5.609858	0.0001
Lnls_manu	-6.123903	0.0000
Lnhealth	-5.403225	0.0001

Table 5.2 reflects the results of the Unit Root (ADF) test. The variable ln (GDP) has unit root not stationary, but after taking the first difference ln (GDP) has become stationary at 5% level of significance. In (Edu.) has stationary having value at 10% level of significance. In (Health) got stationary value by taking first difference at 1% level of significance. Some of the variables are stationary at 1(0) while some others are stationary at 1(1) which clearly depicts that ARDL approach can be applied as the variables are the blend of stationary values at level and first difference.

5.3 Optimal Lags:

The results of optimal lags are shown in Table 5.3.

Table 5.3: Results of Optimal lags

Lag	**LogL**	**LR**	**PE**	**A/C**	**SC**	**HQ**
0	92.44269	NA	.52e-10	-5.57948	-5.299402	-5.486475
1	259.3188	258.3889	.44e-14	-14.02057	-12.07775*	-13.38726
2	307.8130	56.31584	.04e-14	-14.82665	-11.21855	-13.65050
3	377.2946	53.7922	5.66e15*	16.98675	-11.71338	-15.26776*

	* Indicates lag order selected by the criterion		

The data in table 5.3 shows the following results: -

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

5.4 Bound Test

Bound Test is generally used to determine long run relationship between variables. The results of Bound test are shown in Table 5.4.

Table 5.4 Bound Test Results**:**

F-Bounds Test	**Null Hypothesis: No levels relationship**			
Test Statistic	**Value**	**Sign.**	**l (0)**	**l (1)**
Asymptotic: n=	1000			
F-Statistic	10.210	10	2.80	3
K	5	5%	2.39	2.5%
2.7	3.73	1%	3.0	4.15

Actual sample size	31	Finite Sample: n=35	
	10%	2.331	3.417
	5%	2.80	4.013
	1%	3.9	5.419
Finite Sample: n=30			
	10%	2.407	3.517
	5%	2.91	4.193
	1%	4.134	5.761

Sources: Based on Authors' calculations

The table 5.4 illustrates that the value of F-statistics is 10.21084 which is more than from both of upper 1(1) and lower 1(0) bound values, because of this reason null hypothesis is not accepted are there exist a long run relationship among the values of variables. Thus, null hypothesis is rejected while alternate hypothesis is accepted,

5.5 ARDL approach

The long run analysis depicts the impact of independent variables on the dependent variables. The outcomes of long run analysis are shown in the Table 5.5.

Table: 5.5 Results of ARDL Model

Level Equation: Case 2: Restricted Constant and No Trend				
Variables	Coefficient	Std. Error	t-Statistics	Prob.
LNLS_MANU	-0.169252	0.029054	-5.825466	0.0003
LNLABOR	-2.128510	0.256907	-8.285150	0.0000
LNHEALTH	0.177952	0.026371	6.747925	0.0001
LNEXPORT	0.711901	0.054753	13.00197	0.0000
LNEDU	-0.415968	0.047425	-8.771085	0.0000
C	20.51505	1.166683	17.58408	0.0000
EC = LNGDP - (-0.1693* LNLS_MANU -2.1285* LNLABOR + 0.1780* LNHEALTH+ 0.7119*LNEXPORTS -0.4160* LNEDU + 20.5150)				

Source: Authors' calculations

The results in Table 5.5 shows association between variable as it reveals that one-unit changes in the large manufacturing will likely to be increased by 16.92% in GDP and one-unit changes in labour force will likely to decrease GDP by 21.12 percent because it will increase unemployment rate. However, one-unit improvement in healthcare will have positive impact on GDP by 17.79 percent because healthy lab our will be willing to work long hour and in turn increases the level of productivity. Similarly, one unit increases in the export of goods and services will increase GDP significantly by 71.19 %.

The impact of education is also significant because one unit increases in education level will likely to improve GDP by 41.59%. In short, all variables except lab our force have significant positive relationship with GDP in the long run. Thus, the manufacturing sector may be given incentives to

improve their performance. In the same way, education, health and export sectors should be given more incentives for acceleration of growth.

4.6 Error Correction Model

The short run results calculated through ECM are shown in Table 5.6.

Table: 5.6: Results of Error Correction Model

Sample 1985 2018. (Observations: 31)

Conditional Error Correction Regression				
Variables	Coefficient	Std. Error	t-Statistics	Prob.
C	17.13363	3.913090	4.378542	0.0018
LNGDP (-1) *	0.835174	0.187655	-4.450583	0.0016
LNLS_MANU (-1)	-0.141355	0.041645	-3.394270	0.0079
LNLABOR (-1)	0.777675	0.438116	-4.058545	0.0029
LNHEALTH (-1)	0.148621	0.033760	4.402276	0.0017
LNEXPORTS (-1)	0.594561	0.138074	4.306099	0.0020
LNEDU (-1)	-0.347406	0.076629	-4.533583	0.0014
D (LNLS_MANU)	-0.090614	0.025705	3.525158	0.0065
D (LNLS_MANU (-1))	0.042763	0.014741	2.900909	0.0176
D (LNLS_MANU (-2))	0.023018	0.012245	1.879769	0.0928
D (LNLABOR)	0.80795	0.240079	3.365379	0.0083
D (LNLABOR (-1))	2.076441	0.620694	3.345355	0.0086
D (LNLABOR (-2))	0.73721	0.318095	2.317589	0.0457
D (LNHEALTH)	0.071200	0.019048	3.737953	0.0046
D (LNHEALTH (-1)	-0.010628	0.019487	-0.545369	0.5988
D (LNHEALTH (-2))	0.020429	0.020969	-0.974257	0.3554

D (LNEXPORTS)	0.137756	0.029653	4.645601	0.0012
D (LNEXPORTS (-1))	-0.076508	0.063160	- 1.211331	0.2566
D (LNEXPORTS (-2)	-0.088249	0.043482	- 2.029554	0.0730
D (LNEDU)	-0.175749	0.039509	-4.448281	0.0016
D (LNEDU (-1))	0.131577	0.025252	5.210590	0.0006
D (LNLAEDU (-2))	0.107964	0.024458	4.414319	0.0017
*ρ value incompatible with t-Bounds distribution				

Sources: Authors 'calculations

Table 5.6 shows empirical relationship between dependent and independent variables of the model. The short run results show that there is negative relationship between Real GDP and large-scale manufacturing because the coefficient value of large manufacturing shows that one-unit changes in LS-Manu will likely to reduce real GDP by 16.92% in the short run. So, there is a negative relationship between large scale manufacturing and real GDP. There is also a negative relationship between real GDP and labor force as the coefficient value of labor force reflects that one-unit changes in labor force will likely to decrease by 21.28% in real GDP. The variables real GDP and health shows positive association in the short run as the coefficient value of health shows that one-unit changes in health sector will likely to increase real GDP by 17.79% in the short run. There is a negative association between education and real GDP in the short run as expansion of education will likely to cause unemployment among educated workers. The coefficient value of education is -0.415968, which means one-unit changes in education will likely to affect real GDP negative by 41.59 %. These negative relationships between two variables are significant. The results also reveal that one unit increases in the exports of goods and services will likely to increase in real GDP by 71.19

percent in the long run. Thus, the relationship between export and real GDP is significant both in short run and long run. In order to verify long run relationship, we used F-statistics. The calculated results of F-statistics are shown in Table 5.7.

Table 5.7: F-Statistic for Testing long-run relationship

Lags Order	**F-Statistics**
3	10.21084

Table 5.7 indicates that the F-statistic, which is computed to choose greatest lag-period inside the model. According to Pesaran et al. (2001), the upper value is certain at 95% with level of significance, which is 10.21084 respectively with lag order of 3. In this study, Schwarz Bayesian Criterion (SBC) is used to choose the most beneficial lag length of variance protected inside the ARDL model. After determining the long-run relationship, now we discover the short-run relationship in some of the variables in the model. Error correction model is applied for finding the short-run relationship in this model as is shown in Table 5.8

Table 5.8: Results of Error Correction Model (Co-integration form)

Case 2: Restricted constant and no Trend

Selected Model: ARDL (1, 3, 3, 3, 3, 3)				
Variables	**Coefficient**	**Std. Error**	**t-Statistics**	**Prob.**
LNGDP (-1)	0.164826	0.18765	0.878349	0.4026
LNLS_MANU	-0.090614	0.025705	-3.525158	0.0065
LNLS_MANU (-1)-	0.007979	0.017827 -	0.447578	0.6650
LNLS_MANU (-2)	0.019744	0.013974	-1.412916	0.1913
LNLS_MANU (-3)	-0.023018	0.012245	- 1.879769	0.0928
LNLABOR	0.807955	0.240079	3.365378	0.0083
LNLABOR (-1)	-0.509189	0.185092	-2.751006	0.0224
LNLABOR (-2)	-1.339228	0.398773	-3.358373	0.0084
LNLABOR (-3)	-0.737214	0.318095	- 2.317589	0.0457
LNHEALTH	0.071200	0.019048	3.737953	0.0046
LNHEALTH (-1)	0.066794	0.028305	2.359815	0.0426
LNHEALTH (-2)	0.031057	0.028361	1.095051	0.3019
LNHEALTH (-3)	0.020429	0.020969	-0.974257	0.3554
LNEXPORTS	0.137756	0.029653	4.645601	0.0012
LNEXPORTS (-1)	0.380297	0.101050	3.763471	0.0045
LNEXPORTS (-2)	0.011740	0.052635	0.223053	0.8285
LNEXPORTS (-3)	0.088249	0.043482	2.029554	0.0730
LNEDU	-0.175749	0.039509	-4.448281	0.0016
LNEDU (-1)	-0.040080	0.031235	-1.283176	0.2315
LNLAEDU (-2)-	0.023614	0.018904	- 1.249149	0.2431
LNLAEDU (-3)	-0.107964	0.024458 -	4.414319	0.0017
C	17.13363	3.913090	4.378542	0.0018

R-squared	0.999840
Mean dependent var	15.68505
Adjusted R-squared	0.999466
S.D. dependent var	0.385828
S.E of regression	0.008913
Akaike info criterion	-6.420092
Sum squared resid	0.000715
Schwarz criterion	-5.402424
Log likelihood	121.5114
Hannan-Quinn criterion	-6.088358
F-statistic	2676.720
Durbin-Watson stat	2.407620
Prob(F-statistic)	0.000000
*Note: ρ-values and any subsequent tests do not account for model selection	

Source: Authors Calculations

The table 5.8 reveals the short- run results of the variables. The outcomes of the variables show that the error correction coefficient value which is 17.13363 indicates the divergence from long-run values to short-run values. There may be a positive association between labour, exports and health variable in the short-run. The results also show that there might be economic development as well as economic growth during study period. With the lag 1, lag 2 and lag 3 the association of the various variables are effective or ineffective respectively.

The relationship between real GDP and large-scale manufacturing is negative in the short run, this means that that effect of technology in large scale manufacturing is inverse in Pakistan. It is identical at lag 1, lag 2 and

lag 3. However, the lag 1, lag 2 and lag 3 are negatively correlated with GDP growth in Pakistan. Health also has positive association with GDP growth because introduction of technology improves health services and make workers healthier and effective. The lag 1 and lag 2 are positively related to the GDP while lag 3 has negative association with the GDP growth. The association between exports and GDP is negative in the short run, which means that exports have negative effect on GDP in the short run. It is identical at lag 1 but negative at lag 2 then additionally positive at lag 3. The Education is negatively associated with GDP in Pakistan in the short run displaying the impact of technology in education sector will likely to decrease GDP. The lag 1, lag 2 and lag 3 are also negatively related with the
GDP growth in Pakistan. The value of R^2 is 99 98 showing the model of the study is goodness of fit and it indicates that more than 99% variation in the dependent variable is caused by the independent variables. It means that all independent variables have significant effect on dependent variable.

5. Findings of study:

This study examines the value of technology and its impact on Pakistan's economic growth. In order to determine introduction of technology in different sectors of the economy and value addition we collected data from 1985 to 2018 relating to variables such as Gross Domestic Product (GDP) as dependent variable and Large-Scale Manufacturing sector, Labor force, Health, Education and Exports as independent variables. The data was analyzed through statistical techniques such as Descriptive statistics, Correlation Analysis, ADF Test, Bound Test, F-Statistics, ARDL and Error Correction Model. The findings of the study show that manufacturing, Health,

education and exports have positive relationship with GDP while lab our force has negative association with GDP in the long run. The reason is that increase in lab our force will increase unemployment rate due to low capacity of economy to produce more jobs and absorb new entrants in the lab our force. So, the estimated results show one unit increases in lab our force will likely to reduce GDP by 21.12 percent in the long run while one unit increases in manufacturing, health, education and exports will likely to increase GDP by 16.92%, 17.79%, 41.59%. and 71.19 %., respectively in the long run. It means that education and exports are more significant sector of the economy which exert large positive effect on the economy in the long run. The increase in education will enhance the volume of human capital while increase in exports will enhance national income and foreign exchange reserve of Pakistan. Thus, the introduction of technology in these two sectors will bring substantial positive impact on Pakistan economy. The impact of growth in large scale manufacturing and health sectors also have moderate positive effects on the economy. So, the adoption of latest technologies in these sectors will also improve their productivity. These results support the findings of Gruber (2010) and Ndesaulwa, (2016) who found that introduction of technology improved the productivity in health and manufacturing sectors.

The short run results show that the expansion in large scale manufacturing sector, educational facilities, healthcare and exports have negative association with economic growth while increase in lab our force has positive association with GDP. The coefficient values of manufacturing, health, education, and exports are -0.9%, -0.1%, -0.17% and 0.7%. These

values show that negative insignificant association between GDP and manufacturing, health, education and exports. The cause of negative relationship in short run is that large scale manufacturing sector is performing poor in Pakistan because of energy crisis, high prices of raw material and dumping goods and in Pakistani market. Moreover, large manufacturing sector are using outdated technology, causing high cost of production and high price and low quality of products. Moreover, the manufacturing sector is producing primary goods which fetch low price in the international market. This is the main reason of negative relationship between large scale manufacturing sector with GDP. Similarly, health sector also has low performance due to using old medical techniques, causing high mortality rate. So, the ineffective health sector has no positive effect on GDP until it adopts latest health technologies. The expansion of education sector also has negative effect on GDP in the short run because it produces more graduates who do not find relevant jobs and their unemployment is the main issue in Pakistan. So, it is the need of hour to produce graduates having market related education and skill so that they can get job quickly. They must be well-acquainted with the tools of information technology as well. The cause of negative association between exports and GDP is that Pakistan has very low volume of exports vis-à-vis imports. For example, in 2021-2022 Pakistan exported goods and services worth around USD 31 billion against import of USD 81 billion. The size of Pakistan's GDP is around USD 350 billion, the share of exports in total GDP is around 10.33%, which is very low. However, if Pakistan abandoned strategy of producing primary goods and manufacture high-tech products it can enhance its exports

substantially in the long run. When we compare short run and long run results, we can come to the conclusion that all variables having insignificant negative relationship with GDP in the short run but have significant positive relationship with GDP in the long run except labour. These results are consistent with the findings of Driouchi (2015) and Mehmood and Siddique (2001) who also found the same results in their studies.

6. Conclusion:

Pakistan has been using old technologies and producing primary products since long in every sector of the economy and this is the main reason of low productivity, high inflation, unemployment and high population growth rate. The main cause of Pakistan's low productivity is that Pakistan is still exporting raw cotton while textile, which is the main industrial sector of the economy, is producing primary items like yarn, gray cloth and low-quality garments. This sector avoids to adopt latest technology due to unavailability of skilled and relevant labour. They are enjoying the low-cost labour which is suitable for producing primary products. Similarly, the agriculture sector of Pakistan is also very backward and its production and crop yield are three times low as compared to other countries. More than sixty percent population are involved in this sector and is producing crops mostly for self-consumption. The reason is that cultivation and harvesting methods are very old and the farmers are reluctant to adopt new technologies due to financial constraints, poverty and low education.

The health sector is also inefficient and number of medical doctor and nurses are very low as compared to number of patients and the medicines are also low quality and ineffective. Due to these reasons, the mortality rate is

very high. Most of the patients are died particularly in the rural areas, where 58% population live, due to unavailability of health facilities and relevant medicines. The education system is also poor because it is producing non-skilled graduate, who could not get employment after completing education and wait for a long or migrate to abroad. The education is not market-related and the graduates have no proper knowledge of information technology. They just know to open computer but they do not understand computer programming and utilizing them for business purpose. This is the reason that unemployment is increasing in educated youth, which has to worked in informal sector on low wages in order to survive in the society.

Thus, we can conclude that Pakistan will have to adopt latest technology in all sectors of the economy if it wants to make progress and utilize its physical and human resources efficiently to improve their productivity. The relevant education, effective health system, advanced manufacturing and agriculture sectors bring economic revolution in Pakistan.

7.Policy Implications:

The low GDP growth, low productivity of manufacturing and agriculture sectors and inefficient education and health systems are serious challenge for policy makers, who should opt proactive approach to introduce latest technologies in every sector of the economy to make Pakistan a developed economy. The rising unemployment in the educated youth is also serious challenge and one of the main causes of unrest in the country. It needs immediate policy initiative to encourage private sector to create jobs and provide employment to educated youth. The financial institutions must encourage entrepreneurship by providing soft loans to educated persons so

that they can start their own businesses. As the youth has fresh ideas and if proper financial support is provided it can make innovations in the business and serve the society and country efficiently. The major policy implication of this study is that manufacturing sector is continuously weaken and industries are closing day by day due to in competitiveness. The policy makers should focus on this issue and provide necessary fiscal incentive to enhance its competitiveness. It will not only enhance production of goods and services but also reduce unemployment and poverty level from the country.

8. Contribution of this study:

This study contributes into the body of knowledge because it pinpoints major causes of low productivity of manufacturing and agriculture sectors and weakness of education and health sectors. This study highlights the importance of the adoption of technologies for increasing economic growth, alleviating poverty, reducing unemployment and enhancing technical skill of lab our and educated youth. This study also reveals the causes of low share of exports in total GDP and its importance in the growth of country in the long run if latest technologies are introduced in exporting industries. The existing large gap between exports and imports is that Pakistan has been producing low quality products which has no demand in international market. This study suggests Pakistan will have to change its traditional business strategy and adopt latest technologies to enhance its competitive in international market.

9. Limitations and direction for further research:

This study included six variables like large scale Manufacturing, lab our, health, education and exports and GDP into this analysis. The other researchers can expand this study by including service sector into their sample.

They can also take both manufacturing and services sectors of Pakistan and can compare their efficiency and productivity in order to understand which sector is most effective and beneficial for increasing national income, employment and decreasing poverty and unemployment. The other researchers may also focus on skill development of youth in order to highlight its importance and practical value in getting quick jobs and high earning.

Data statement:

The data that supports the findings of this study will be available by corresponding author on request.

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REFERENCES

Ahmad, S. (2008). Impact of Information Technology on Productivity. A Master's Thesis submitted to Tarbiat Modares University, Iran. (Google Scholar)

Amjad, Rashid, (2006). Why Pakistan must break-into the knowledge economy, MPRA Paper 34448, University Library of Munich, Germany. (Google Scholar)

Awan, Abdul Ghafoor, Mukhtiar, Aroosa (2020) Agriculture productivity and economic growth: A case of Pakistan. *Global Journal of Management, Social Sciences and Humanities.* 6 (3). (Google Scholar)

Awan, Abdul Ghafoor. Mushtaq, Sidra (2020). The effects of technological innovation on employment: Evidence from Manufacturing sector of Pakistan. *Global Journal of Management, Social Sciences and Humanities*. 6, (3) (Google Scholar)

Awan, Abdul Ghafoor (2014). Brazil's Innovative Anti-Poverty & Inequality Model, *International Journal of Development and Economic Sustainability* 2 (5): 45-55 (Google Scholar)

Awan, Abdul Ghafoor (2012). Diverging Trends of Human Capital in BRIC countries**,** *International Journal of Asian Social Science***,** 2 **(**12): 2195-2219. (Google Scholar)

Awan, Abdul Ghafoor (2012) Human Capital: Driving Force of Economic Growth in Selected Emerging Economies, *Global Disclosure of Economic and Business,* 1 (1): 09-30 (Google Scholar)

Awan, Abdul Ghafoor)2016). Wave of Anti-Globalization and capitalism and its impact on world Economy, *Global Journal of Management and Social Sciences*, 2 (4): 1-21. (Google Scholar)

Awan, Abdul Ghafoor (2015). Analysis of the impact of 2008 financial crisis on economic, political and health systems and societies of Advanced countries, *Global Journal of Management and Social Sciences* 1 (1): 1-16. (Google Scholar)

Awan, Abdul Ghafoor (2015). State Versus Free Market Capitalism: A comparative Analysis. *Journal of Economics and Sustainable Development*, 6 (1): 166-176 (Google Scholar)

Awan, Abdul Ghafoor, Mukhtaar, Sheeza Sadia (2019). Causes of trade deficit and its impact on Pakistan's Economic growth. *Global Journal of Management, Social Sciences and Humanities*, 5 *(*3): 480-498 (Google Scholar)

Awan, Abdul Ghafoor (2014). Shifting Global Economic Paradigm, Asian *Business Review*, 4 (3): 113-118 (Google Scholar)

Awan, Abdul Ghafoor (2011) Changing World Economic and Financial Scenario, *Asian Accounting and Auditing Advancement*, 1 (1): 146-175 (Google Scholar)

Awan, Abdul Ghafoor, Nadeem, Nasir., Malghani, Falak Sher (2015) Causes of loan defaults in Pakistani Banks: A case study of District D.G. Khan, *Science International,* Lahore 27 (3): 2593-2597 (Google Scholar)

Awan, Abdul Ghafoor, Ramla Hussain (2021) Role of IMF Program in stabilization of Pakistan's economy, *Global Journal of Management, Social Sciences and Humanities* 7 (2) (Google Scholar)

Braunerhjelm, Pontus, (2010). *Entrepreneurship, Innovation and Economic Growth - past experience, current knowledge and policy implications,* Working Paper Series in Economics and Institutions of Innovation 224, Royal Institute of Technology, CESIS - Centre of Excellence for Science and Innovation Studies. (Google Scholar)

Driouchi, Ahmad (2015) New Health Technologies and Health Workforce in Developing Economies, IEAPS, Al Akhawayn University, Ifrane, Morocco https://mpra.ub.uni-muenchen.de/67993/MPRA Paper No.67993. (Google Scholar)

Freeman. (2014). The management of innovation and Technology. *Journal of Innovation and Technology. Journal of Technology.* (Google Scholar)

Gruber, H., & Koutroumpis, P. (2011). Mobile telecommunications and the impact on economic development. *Economic Policy*, 26 (67), 387-426. (Google Scholar)

Gerguri, Shqipe & Ramadani, Veland, (2010). The Impact of Innovation into the Economic Growth, MPRA Paper 22270, University Library of Munich, Germany. (Google Scholar)

Government of Pakistan (2018), Statistical Yearbook. Islamabad: Federal Bureau of Statistics, Government of Pakistan. (Google Scholar)

Hussain, Dilshad, Awan, Abdul Ghafoor (2016). Effects of Technical innovation on rural employment in agriculture sector in District Vehari-Pakistan., *Global Journal of Management and Social Sciences* 2 (4): 39-56. (Google Scholar)

Information Technology (2021) Relief to software companies to help boost Forex earnings (2001), Business *Recorder*, 18th May. (Google Scholar)

Jafarieh, H. (2001). Technology transfer to developing countries: A quantitative approach (Doctoral dissertation, University of Salford, UK). (Google Scholar)

J. E. Aubert, et al. (2007) *Building Knowledge Economies: Advanced Strategies for Development*, World Bank. (Google Scholar)

Khan, S., Khan, S., & Aftab, M. (2015). Digitization and its impact on economy. *Int. J. Digital* Libr. Serv, 5(2). (Google Scholar)

Knutsen, C. H. (2012). *Democracy, technological change and economic growth*. Technical report, Department of Political Science, University of

Oslo. (Google Scholar)

Mehmood, Z and Siddique, R. (2001) State of Technology and Productivity in Pakistan's Manufacturing Industries: Some Strategic Directions to Build Technological Competences. (Google Scholar)

Miah.M and A. Omer (2012) Technology Advancement and Developing Countries during Digital Age. (Google Scholar)

Ndesaulwa, Andrey.Paul,. Kikula, Jaraji (2016). The impact of Technology and Innovation (Technovation) in Developing Countries: A Review of Empirical Evidence. *Journal of Business and Management Sciences*, 4(1):7-11 doi: 10.12691/jbms-4-1-2. (Google Scholar)

Nepelskin, Daniel, De Prato, Gaudete (2015) International technology sourcing between a developing country and the rest of the world. A case study of China. *Technovation* 35: 12-21 (Google Scholar)

Nelson, Richard R. (2005). *Technology, Institutions and Economic Growth . Cambridge*, MA:Harvard University Press. (Google Scholar)

Pakistan to hold global information technology (IT) moot (2001), Daily The Nation, 23rd May. (Google Scholar)

Government of Pakistan. Pakistan *Economic Survey. (Various issues)* Ministry of Finance, Economic Adviser's Wing, Islamabad.

(Google Scholar)

Romer, P., (1990), Endogenous technological change, *Journal of Political Economy*, 98 (5), Part 2. (Google Scholar)

Saeed, Fozia., Awan, Abdul Ghafoor (2020). Does technological advancement really affect economic growth of Pakistan. *Global Journal of Management, Social Sciences and Humanities*, 6 (2). (Google Scholar)

Saggi, K. (2004) *International technological transfer to developing countries*, London: Common wealth Secretariat. (Google Scholar)

Sarwar, Ghulam, Awan, Abdul Ghafoor, Siddique, Kalsoom (2014) The Effect of Economic Value Added on Stock Return: Evidence From Selected Companies of Karachi Stock Exchange, *Research Journal of Finance and Accounting* 5 (23):140-150 (Google Scholar)

Schrettle (2013), Managing Manufacturing Process Innovation – New Manufacturing Technology Adaption as a Dynamic Capability. (Google Scholar)

Schultz, T. P. (1994), *The Role of Education and Human Capital in Economic Development: An Empirical Assessment.* H. Siebert (ed.) Economic Growth in the World Economy. (Google Scholar)s

Shan, Mehmood and Satar (2014) Innovation and Economic Development: A Case of small and Medium Enterprises in Pakistan. (Google Scholar)

Sukla.S (2017) Innovation and Economic Growth: A Case Study of India. (Google Scholar)

Vuckvic.M (2016). The Relationship between Innovation and Economic Growth in Emerging Economies. (Google Scholar)

Zahra, Syeda Zuriat-ul, Awan, Abdul Ghafoor (2014) Impact of Innovations on consumers' behavior: A case study of Pak Electron Limited. *European Journal of Business and Innovation Research,* 2 (6):93-108 (Google Scholar)