

Research Article

**DIGITAL TRANSFORMATION, HUMAN CAPITAL AND
ECONOMIC PERFORMANCE IN PAKISTAN**

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Abstract:

The objective of this research paper is to investigate relationship between digital technologies, human capital, foreign direct investment and balance of payment with economic growth. 22-years' time series data spanning 2000 to 2022 was used and sourced from World Development indicators, Pakistan Economic Survey and the State Bank of Pakistan, Economic growth is dependent variable, while digital technologies, foreign direct investment, human capital and balance of payment are independent variables. The study used various statistical techniques such as correlation analysis and multiple regression analysis to determine the relationship between variables. The empirical results reveal that there is negative association between FDI and economic growth in Pakistan, whereas there is positive and significant relationship between digital technologies, human capital, and balance of payment with economic growth in the long-term.

Keyword: Digital Transformation; Human Capital; Economic performance.

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1. Introduction

The digital economy brought significant changes in the way of doing business, increased fierce competition, widens the scope of marketing, enhances affordability of products and open door for entering international markets. The shift to a digital society has had a profound influence on the nature of jobs skills, and economic preferences. To fully leverage the potential of human capital, it is imperative to devise effective policies to enhance accessibility of the people to education and healthcare services. Baro and Lee (1994) investigated the drivers of economic growth by taking a sample of 116 countries and using data from 1965 to 1985. They found that a country having lower real per capita GDP grows faster relative to its initial level of human capital in the shape of educational attainment and health; showing a positive impact on growth from a high ratio of investment to GDP. Slow-Swan model (1956) highlighted the importance of capital stock, technological advancement in economic growth and argued that the countries having more capital stock, advanced technologies and human capital get fast economic growth than those countries, which lack these important drivers of growth. Romer (1993) identified the relationship between investment in R&D and technological advancement. He emphasized that more investment in research and development had positive impact on innovations and economic growth. Jaffri, et al (2012) examined foreign direct investment (FDI) inflow, ecological standards, skilled labor, and economic growth in the Mediterranean area during 1990-2013. Dawda et al. (2019) scrutinized 13 industrialized and 11 emerging economies and concluded that investing in natural resources and education had strong impact on GDP growth in industrialized economies compared to the emerging economies (Akpolat, 2014) noted that Education

plays a key role in decreasing socioeconomic disparity, and the secondary level education has more profound effect than the elementary level. Abdullah, (2015) emphasized that human resources development leads to innovation and foster economic progress all over the world. A causal unidirectional link was manifested between healthcare expenses, training, education expenses and GDP growth, while a unidirectional relationship was found between healthcare expenses and GDP (Osiobe, 2019). A study conducted in the Shandong Province of China using data from 2005 to 2019 found strong positive association between financial development and human capital (Wang, 2022).

The above discussion demonstrates that digital technologies, human capital, balance of payment and foreign direct investment have close association with economic growth. Therefore, the aim of this study is to investigate long-term relationship between variables, using time series data spanning 2000 to 2022 and using relevant statistical techniques. The findings of this study will provide valuable insights for understanding complex relationship between variables. The findings will also enable the policymakers to frame effective policies to promote technologies in all sectors of the economy and develop human capital through education and training to enhance productivity of labor. The findings also provide guidance to the policymakers to control trade balance to reduce huge trade deficit due to excessive imports and low exports in Pakistan.

2. Theoretical and empirical analysis

2.1 Theoretical analysis

Economic growth is a very important issue in every country because every country strives to increase it to reduce unemployment, create jobs, and uplift living standards. Generally, it is referred to the increase in production and

consumption of goods and services in an economy over a specific period of time, and it is generally measured by the percentage increase in gross domestic product in the current year compared to the previous year. Schumpeter's (1934) theory of economic growth is based on continuous innovation and technological advancement, and he used the term "creative destruction," which posits that new technologies or entrepreneurial innovations kick out old companies or products from markets and force companies either to innovate or exist from the market. Thus, economic growth is crucial for continuity of business and survival of business firm as well as for uplifting of living standard.

Samuelson, et al. (1953); Solow's (1956) and Swan, (2002). in their theories of economic growth identified relationship between technological advancement, capital accumulation, human capital and productivity improvement. Continuous upward economic growth upgrade living standards, generate employment opportunities, increases per capita income and bring overall prosperity to society. Governments and policy makers all over the world strive to trigger economic growth by developing infrastructure, improving education and health care services, and adopting pro-growth policies to speed up economic growth. Romer's (1990) theory of economic growth is based on human capital development and investment in Research and Development (R&D) to accelerate economic growth. He emphasizes that investment in R&D must be made to boost innovation and improve human capital. This sentiment is not a new as International Monetary Fund (1999) also recognized that all countries attract foreign direct investment to enhance economic growth.

In contrast, academic literature speak another story because very few recent research studies found a positive link between FDI and economic

growth. Borensztein, Gregorio, and Lee (1998) argued that the impact of FDI on economic growth is positive only when the education level of host country is better and skilled labor force is available. They suggested that the developing countries should be cautious in attracting foreign direct investment because of its negative impact on low-income countries. Krugman (1998) expressed apprehension about the positive impact of FDI on economic growth and advised the developing countries to adopt cautious approach toward FDI. He argued that multinational corporations sometimes take over control of domestic firms due to their competency and financial power, which local firms do not have. Sometimes they purchase assets of local firms and establish their monopoly. Hausmann and Fernández-Arias (2000) contended that high inflow of FDI is a sign of weakness of host country rather than its strength and it increases risks which can be measured either by host country's credit rating for sovereign debt or by other indicators of country risk. This risk is increased when the country's institutions are weak. They suggested that that countries trying to avail funds from international capital markets should focus on developing strong institutional mechanisms instead of trying to get more FDI. They also suggested that the countries seeking foreign capital should improve their investment environment and functioning of markets to attract FDI. The share of capital inflow is higher in the countries where domestic policies and institutions are weak. Without strong institutions, seeking FDI might increase economic stress in the host country. Foreign direct investment is not only a transfer of ownership from local to foreigners but also enable foreigners to exercise management and control over host country's firms. Benetrix, Pallan, Panizza (2023) presented opposite picture of FDI by pleading that that policymakers in both developing and developed countries agree that FDI is a key driver of economic growth. The European Commission states that FDI is

a driver of competitiveness and economic development. The World Bank, during COVID-19 pandemic, declared that FDI as a key source of recovery.

2.2 Empirical analysis

2.1 Foreign Direct investment (FDI)

The above theoretical discussion indicates close association between technological advancement, human capital, foreign direct investment and economic growth. This theoretical framework provides foundation for developing hypothesis for this study and testing statistical relationship between selected variables of this study. Now we briefly examined relevant empirical literature to understand statistical relationship between FDI, Human Capital, Technology, Balance of Payment and Economic growth.

The empirical results of previous studies on the relationship between FDI and economic growth are mixed. For example, the study of Jugurnath et al. (2016) examine the impact of FDI on economic growth in SSA using a panel data of 32 countries spanning from 2008 to 2014. Their result indicates that FDI has a positive impact on economic growth. Nketiah-amponsah and Sarpong (2019) estimated the impact of infrastructure and foreign direct investment on economic growth and found that FDI has a positive impact on economic growth when the infrastructure of host country is strong. Makiela and Ouattara (2018) conducted a comparative study using a sample of developed and developing countries over the period from 1970 to 2007. They found that FDI positively contributes to the economic growth of the host countries. Mohd and Muse (2021) analyzed the impact of FDI on Ethiopian economy using the VAR model and data from 1981 to 2017. Their findings show that FDI has a positive impact on economic growth both in the short and long run. Similarly, Nguyen (2020) conducted a study on Vietnam over a

period from 1997 to 2018, and noted that foreign direct investment has a positive impact on economic growth. In contrast, the positive findings of above studies, there are many studies which reveal negative impact of FDI on host countries. For example, OECD (2002) highlights the drawbacks of foreign direct investment on the domestic economy. Foreign direct investment may deteriorate the BOP of the host country due to repatriated profit, lack of positive linkage with local enterprises, harmful environmental impact, social disruptions, and it may harm competition in the domestic market. Multinational enterprises may crowd-out domestic investment due to their superiority in technology, capital, and managerial skills over their domestic competitors (Kumar; Markusen & Venables, 1999). Loungani, Prakash and Assaf Razin (2001) investigated the impact of FDI on economic growth and argued that despite strong theoretical arguments in favor of free capital flows, the conventional wisdom appears to be weak because too many private capital flows pose countervailing risks. Hausmann and Fernández-Arias (2000) contended that capital flow, in fact, is international debt flow and produces “bad cholesterol”. Most of the time lending from abroad is speculative nature based on interest rate differentials and exchange rate fluctuations in the short term. They also argued that FDI produces “good cholesterol” when it is on long-term basis in fixed assets and could not be withdrawn during economic crisis because capital flight during crisis further worsens the economic condition of host country. Ayenew (2022) examines the impact of foreign direct investment on the economic growth in 22 Sub-Saharan African countries, using panel data from 1988 to 2019 and applying ARDL model to determine short-and long-term effects of FDI on economic growth. His findings show a positive impact of FDI on economic growth in the long-term but its impact is insignificant in the short-term. Adams-Kane and Lim (2016)

identified relationship between quality of organizations, academic achievements, and foreign direct investment. This study found positive impact of FDI on human capital and per capita income. Borensztein, Gregorio and Lee, (1998) and Sasi, et al, (2015) measured the impact of foreign direct investment (FDI) on economic growth using data on FDI flows from industrial countries to 69 developing countries over the last two decades. Their findings suggest that FDI is an important vehicle for the transfer of technology, capital, and accelerating growth more rapidly than domestic investment. However, achieving higher level of productivity by the host country depends on the availability of relevant human capital. It is necessary for a host country to enhance its absorptive capability of advanced technologies through improving the skills of workers (Zhang, 2023; Assi, 2023). This discussion highlights that foreign direct investment (FDI) is positively associated to economic growth. Therefore, we suggest the first pair of hypotheses:

H₀: Foreign direct investment is not positively related to economic growth

H₁: Foreign direct investment is positively related to economic growth.

2.2 Balance of payment

The balance of payments refers to a country's economic transactions with the rest of the world, comprising the current account, capital account, and financial account. Imbalances in the balance of payments can affect GDP growth through various channels. Recent studies have highlighted the significance of balance of payments on Pakistan's economic performance. Ahmed et al. (2020) analyzed the impact of balance of payments on GDP growth in Pakistan. They found that persistent current account deficits exerted downward pressure on GDP growth, primarily due to reliance on external borrowing to finance the deficit. Their findings underscored the importance of addressing structural imbalances in the balance of payments to sustain higher

GDP growth rates. Studies by Zaiby (2009) and Mahmood & Chaudry (2023) highlighted the role of high import dependence and lagging exports in trade deficit. These studies a negative association between balance of payment and economic growth. Thus, we propose the second pair of hypotheses:

H₀: Balance of payment (BOP) is negatively related to economic growth.

H₁: Balance of payment (BOP) is positively related to economic growth.

2.3 Technological advancements

Romer (1993) identified different gaps in economic development. A nation that lacks physical objects like industrial and communication infrastructure suffers from an object gap. A nation that lacks the knowledge used to create value in a modern economy suffers from an idea gap. Object gaps are emphasized by mainstream economists who make use of formal models and statistical hypothesis tests. Idea gaps are emphasized by dissident economists who make use of a diverse body of evidence and avoid formal models. Economists need to use the formal models from the first approach and the diverse evidence from the second to fully appreciate the importance of idea gaps in economic development. Hülya and Öúkan (2015) argued that differences in economic growth and income inequality could be explained on the basis of technological differences because technology reduces cost and triggers productivity gains. The new technology usage helps produce cheaper goods and accumulate wealth by increasing global competitiveness. However, technological advancement has several implications regarding the reflection of growth on people's life, or people's participation in growth process, all people enjoy the benefit of growth or technological progress reduces the welfare of people. These studies show close link between technological advancement and economic growth. Therefore, we can suggest third pair of hypotheses:

H₀: Technological advancement is negatively associated to economic growth.

H₁: Technological advancement is positively associated to economic growth.

2.4 Human Capital Development

Schultz, (1961) and Becker, (1962) emphasized that development of human resources offers a wide range of advantages for the overall economy, society, and people of a country. Therefore, superior learning, medical facilities, low crime rates, strong regulations and safe working environment are crucial factors that influence the progress and advancement of an economy. Mencer, (1970) investigated causal relationship between schooling and GDP concluded that investment in human resources expedited economic development. Psacharopoulos and Woodhall, (1985) investigated relationship between investment in human capital and economic growth using annual data from 28 countries spanning from 2000 to 2012. The study examined relationship among the gross domestic product (GDP) per capita income, human capital, education expenditures, employment, goods and services, exports, and the number of patents filed. They found close link among these variables and their positive impact on economic growth. Akpolat (2014) underlined the significant role of human and natural resources in GDP using time series data from 1970 to 2011. The writer scrutinized 13 industrialized and 11 emerging economies and identified that investing in natural and human resources had a greater impact on GDP in the industrialized nations compared to the emerging economies. Anyanwu (2014) examined the impact of education on economic growth in Africa and found that secondary level education had significant impact, whereas loans to private sector had insignificant impact on economic growth in African countries. Gruzina et al. (2021) argued that economic growth is only possible by developing human resources, which consequently enhances a nation's potential for innovation. The growth disparity between developing and developed nations is because of the former's greater

productivity levels, whereas the latter has attained high productivity levels because of its greater proportion of human capital. Thus, the above discussion shows that human capital is positively associated with economic growth. Therefore, we can suggest the fourth pair of hypotheses:

H₀: Human capital is negatively associated with economic growth.

H₁: Human capital is positively associated with economic growth.

2.6 Novelty of study

The novelty of this study is that it examines combined effects of technological transformation, human capital, balance of payment and foreign direct investment on economic growth. It may be noted that most of the above studies investigated individual impact of these variables on economic growth. The mixed findings of the impact of FDI, Technological advancement and human capital on economic growth provided sufficient research gaps and suggest further investigation to understand complex relationship between these variables in the context of economic growth in Pakistan. By addressing these gaps, the authors have intended to probe into the causes of stagnant economic growth and nominal positive impact of technology, human capital and negative impact of foreign direct investment on economic growth in Pakistan. This comprehensive analysis will provide valuable insights to the policymakers to rationalize their policy framework to promote technology, develop human resources and attract foreign direct investment in fixed assets on long-term basis and also discourage FDI in speculative activities, besides improving balance of payment through balancing imports and exports.

3. Data and Methodology

This study employs a quantitative method to analyze data. The research focusses on the key variables, such as human capital, BOP, FDI, technology and economic growth. GDP growth is dependent variable while technology,

Balance of payment, foreign direct investment (FDI) and labor force (workers) participation are independent variables. The workers are proxied for human capital. The study primarily relies on secondary data spanning from 2000 to 2022 and sourced from World Development indicator, Pakistan Economic Survey and the State Bank of Pakistan. The variables were adopted from different theoretical and empirical studies which are illuminated in [Table 1](#).

Table 1 Variables, their definitions and sources.

S.No	Variables	Definition	Sources
1.	Economic Growth	It refers to the increase in production and consumption of goods and services in an economy over a specific period of time, and it is generally measured by the percentage increase in gross domestic products in the current year compared to the previous year	Slow-Swan model (1954), Baro and Lee (1994), Swan, Trevor W (2002) Gruzina et al. (2021)
2.	Technology	Technology refers to machinery and equipment that enable the production of new goods and services and enhances productivity.	Schumpeter's (1934), Hülya and Öúkan (2015), Romer (1993),
3.	Human Capital	It refers to educated and skilled labor force	Hawkes and Ugur (2012), Akpolat (2014), Gruzina et al. (2021)

4.	Foreign Direct Investment	It refers to the investment made by foreigners in the fixed and financial assets of a country to earn profit or to get ownership in the equity of firms.	Krugman (1998), Hausmann and Fernández-Arias (2000), Makiela and Ouattara (2018), Mohd and Muse (2021)
5.	Balance of payment	It refers to a country's economic transactions with the rest of the world, comprising the current account, capital account, and financial account.	Ahmed et al. (2020), Mahmood & Chaudry (2023)

The study employs various analytical techniques to explore the relationship between dependent and independent variables. Descriptive analysis used to examine central tendency, variability, and scattering in the data set. This method provides a high-level outline of the data and aid in the identification of patterns and relationship. Correlation matrix was used to identify degree of association between pairs of variables, while Multiple Regression analysis was used to determine long-term relationship between independent and dependent variables. These techniques are valid and widely used by researchers in their studies to identify relationship between variables and their impact on economic growth. By employing these statistical techniques, the study aims to provide insight into how digital transformation, human capital, FDI and BOP influence economic growth in Pakistan.

4. Results

As we mentioned above that this study used different statistical tools to explore statistical relationship between independent and dependent variables. Therefore, we elaborate the estimated results of different techniques as follows:

4.1 Descriptive statistics

Descriptive statistics technique is used to identify main features of a dataset, such as its central tendency, variability, and scattering. These method aids in the identification of patterns and nature of relationship between variables. The results of descriptive statistics are presented in [Table 2](#).

Table 2 Descriptive Statistics results

	GDP	BOP	FDI	TECHNOLOG Y	WORKERS
Mean	1242.783	-2.687570	20.07640	1.851351	39.92685
Median	1227.918	-2.101339	15.60173	1.851157	39.58945
Maximum	1620.743	-0.216651	35.56883	2.302693	44.38512
Minimum	884.4410	-9.204316	9.237467	1.448113	36.60081
Std. Dev.	251.7834	2.394665	8.900893	0.252557	2.729078
Skewness	- 0.005070	-1.547324	0.847946	0.136515	0.393722
Kurtosis	1.686834	4.899020	2.331943	2.263926	1.758354
Jarque- Bera	1.005962	7.690156	1.938038	0.359538	1.261023
Probability	0.604725	0.021385	0.379455	0.835463	0.532320
Sum	17398.96	-37.62598	281.0696	25.91892	558.9759

Sum Sq.	824133.2	74.54744	1029.937	0.829204	96.82230
Dev					
Observations	14	14	14	14	14

The mean represents the average value of each variable. For example, the mean of GDP growth is 1242.783 indicating that the average number of GDP growth approximately 1242.78. The median represents the middle value of variables. It gives an idea of the central tendency of the data. For instance, the median of balance of payment (BOP) is -2.10. The maximum value represents the highest observed value in the data. For example, the maximum value of labor force is 44.38, indicating the highest value observed. The minimum value represents the lowest observed value in the data. For example, the minimum value of -9.20. The standard deviation shows the scattering or inconsistency of the data. For example, GDP growth is 251.7834 suggesting a relatively large variation in the number of GDP growth. The skewness measures the irregularity of the data scattering. The positive value skewed the exact skewed distribution, while a negative value indicates a left skewed distribution. For Example, FDI 0.847946 indicates a right skewed distribution. Kurtosis measure the shape of the distribution and indicate the existence of outliers or extreme values.

4.2. Correlation Analysis

The correlation matrix is used to examine correlation between pairs of variables. The value of correlation may be positive or negative and it lies between -1 and +1, showing perfect negative and perfect positive correlation between pairs of variables. The results of correlation matrix are shown in [Table 3](#).

Table 3 Correlation Matrix results

Variables	GDP	BOP	FDI	Technology	Workers
BOP	-57.61416	5.324817			
FDI	1139.223	2.062998	73.56690		
Technology	23.21021	-0.207509	0.534283	0.059229	
		0.393077	-0.369502	0.255955	1.000000
Workers	506.7431	-0.220285	19.91154	0.162955	6.915879
	0.794199	-0.036300	0.882755	0.254611	1.000000

[Table 3](#) shows that all variables except BOP have strong positive correlation with GDP growth. FDI Technology and workers have positive correlation, whereas BOP has negative correlation with technology. The workers have weak positive correlation with technology and FDI

3. Multiple Regression

This statistical technique is used to identify long-term relationship between variables. The dependent variable in this study is economic growth and independent variables are: technology, human capital, FDI and Balance of payment. Ordinary Least Square (OLS) method is used to analyze long-term statistical relationship between variables. The results are divided into two sections: coefficients and model summary and are presented in [Table 4](#).

Table 4 Multiple Regression analysis results

Dependent Variable: GDP
Method: Least Squares
Date: 08/29/23
Time: 18:33
Sample (adjusted): 6 - 19
Included observations: 14 (after adjustments)

Variables	Coefficient	Std. Error	t-Statistic	Prob.
FDI	-23.30263	9.535978	-2.443654	0.0371
BOP	14.87020	17.91634	0.829980	0.4280
TECHNOLOGY	285.1832	168.3910	1.693577	0.1246
Human Capital	134.1172	30.38204	4.414357	0.0017
C (Constant)	-4132.270	1086.175	-3.804423	0.0042

Model Summary

Statistic	Value
R ²	0.801447
Adjusted R ²	0.713201
S.E. of Regression	134.8391
Sum Squared Residual	163634.4

Statistic	Value
Log Likelihood	-85.42947
F-statistic	9.081970
Prob(F-statistic)	0.003190
Mean Dependent Variable	1242.783
S.D. Dependent Variable	251.7834
Akaike Info Criterion	12.91850
Schwarz Criterion	13.14673
Hannan-Quinn Criterion	12.89737
Durbin-Watson Statistic	1.226147

The results in Table 4 shows negative relationship between FDI and economic growth, indicating a one unit increases in FDI is associated with a decrease of economic growth by 23% in the long run, if all other factors remain constant. This is statistically significant with a p-value of 0.0371. The null hypothesis (**H₀**) relating to FDI, is accepted and alternate hypothesis (**H₁**) is rejected because the finding of this study confirmed negative association between FDI and economic growth in Pakistan and these results support to Krugman (1993), Hausmann and Fernández-Arias (2000) and Benetrix, Pallan, Panizza (2023), who found negative association between FDI and economic growth due to weak institutions of host countries.

Balance of payment had positive association with GDP growth in the long run. It means one unit increases in BOP is associated with 14.87% increase in GDP growth in the long run. However, the p-value of 0.4280 indicates that this relationship is not statistically significant. Null hypothesis (**H₀**) related to the

BOP is rejected and alternate hypothesis (**H₁**) is accepted because the finding of this study confirmed positive relationship between balance of payment and economic growth in Pakistan. These results contradict the findings of Ahmed et al. (2020), Zaiby (2009) and Mahmood & Chaudry (2023), who found negative link between balance of payment and economic growth.

Technology also had significant and positive relationship with GDP growth because the coefficient of these variables is 285.1832, indicating strong positive association between these two variables. The p-value of 0.1246 suggests that this effect is not statistically significant. Third null hypothesis (**H₀**), which states that technology is negatively associated with economic growth is rejected and alternate hypothesis (**H₁**) is accepted. This finding supports to Schumpeter's (1934) theory of innovation, Solow-Swan's (1954) model of technological advancement and Romer (1993) theory of investment in R&D. These theories proposed positive relationship between technology advancement and economic growth.

The workers, which is proxied for human capital, had significant positive relationship with economic growth because the coefficient of these variables is 134.1172. This relationship is strong because a highly significant p-value of 0.0017. Thus, fourth null hypothesis (**H₀**), which states that there is no positive association between human capital and economic growth, is rejected and alternate hypothesis (**H₁**) is accepted. These findings are consistent with Baro and Lee's (1994) theory of human capital which suggests a positive relationship between human capital and economic growth. These findings are also support to Hawkes and Ugur (2012), Mehrara (2013), Akpolat (2014), Anyanwu (2014), Pelinescu (2015), and Gruzina et al. (2021), who found positive link between human capital and economic growth. Thus, all independent variables except FDI show significant and positive association

with economic growth in the long run. The results of balance of payment are contrary to economic theory and previous empirical analysis. The possible reason of this negative relationship is that Pakistani policymakers love deficit-financing by printing money to bridge gap between revenue and expenditures and they argue that economic development can be accelerated through development expenditures.

The R-squared value 0.801447 shows 80% variations in the dependent variables due to combined effect of independent variables. The adjusted R-squared 0.713201 accounts for the number of predictors, indicating the model is a good fit. F-statistic (9.081970, $p = 0.003190$) demonstrate that overall model is statistically significant, suggesting that at least one of the predictors is meaningful. To sum up, FDI has negative but effect on GDP growth while human capital has strong positive and significant impact on it. Technology and BOP have positive but statistically insignificant impact on economic growth. The model fits the data because it causes 80% variations in dependent variable.

4.4 Granger Causality Test.

To investigate the bidirectional and unidirectional relationship between variables, Granger causality test is used. This test assesses whether one variable granger cause another variable, showing cause and effects. The results of Granger causality test are presented in [Table 5](#).

Table 5 Ganger Causality Test

Pairwise Granger Causality Tests

Date: 08/29/23

Time: 18:31

Sample: 120

Lags: 2

Null Hypothesis	Obs	F-Statistic	Prob.
TECHNOLOGY does not Granger Cause GDP	12	1.74880	0.2421
GDP does not Granger Cause TECHNOLOGY		2.28558	0.1722
WORKERS does not Granger Cause GDP	17	0.88503	0.4380
GDP does not Granger Cause WORKERS		2.39688	0.1331
FDI does not Granger Cause GDP	17	0.66561	0.5319
GDP does not Granger Cause FDI		9.35856	0.0036
BOP does not Granger Cause GDP	17	2.82890	0.0985
GDP does not Granger Cause BOP		0.23867	0.7913
WORKERS does not Granger Cause TECHNOLOGY	12	0.09288	0.9124
TECHNOLOGY does not Granger Cause WORKERS		0.67533	0.5393
FDI does not Granger Cause TECHNOLOGY	12	1.55699	0.2758
TECHNOLOGY does not Granger Cause FDI		2.15430	0.1866
BOP does not Granger Cause TECHNOLOGY	12	2.24049	0.1770
TECHNOLOGY does not Granger Cause BOP		0.04865	0.9528
FDI does not Granger Cause WORKERS	17	0.97283	0.4059
WORKERS does not Granger Cause FDI		6.76499	0.0108
BOP does not Granger Cause WORKERS	17	1.26333	0.3178
WORKERS does not Granger Cause BOP		0.01216	0.9879
BOP does not Granger Cause FDI	17	1.29635	0.3092
FDI does not Granger Cause BOP		0.15919	0.8546

In the first pair of hypotheses, the value of P is significant in both cases and null hypothesis is rejected. It means that there is no granger causality between GDP and TECH. In the second pair, p value is significant in case of $H_0 = \text{Worker}$ does not cause granger causality on GDP. This case is unidirectional. In third pair of hypotheses, P value is significant $H_0 = \text{BOP}$ does not cause the granger causality GDP; thus, null hypothesis is rejected and p value indicates that the relationship is unidirectional. In fourth pair, p value is significant, and as such null hypothesis is rejected. In fifth pair, p value is insignificant and null hypothesis is accepted as $H_0 = \text{FDI}$ does not cause granger causality GDP. The same situation in in sixth, seventh, eight, nine, tenth pairs of hypotheses. This is unidirectional causality.

Based on these results, it can be concluded that digital technologies and human capital have positive influence on economic growth. These results provide valuable insights into the benefits of digitalization of the economy and human resources development for sustainable growth.

5. Discussion

This study was conducted to analyze relationship between digital technologies, balance of payment, human capital and FDI with economic growth. Workers was proxied for human capital. The dependent variable was economic growth, while all other variables were independent variables. 22-years' time series data from 2000 to 2022 was used to determine long-term relationships between these variables. Various statistical techniques, such as descriptive analysis, correlation matrix, Multiple regression analysis and Granger causality test were used to analyze the data and behavior of variables.

Correlation analysis results showed positive correlation between digital Technologies, FDI and human capital with GDP growth while Balance of

Payment showed negative correlation with it. Multiple regression analysis results demonstrate that FDI has negative association with economic growth, while Technology, human capital and balance of payment have positive relationship with GDP in the long run. The model of the study is a good predictor because it shows from 80 to 71% variations in the dependent variable are due to combined effect of all independent variables. The findings of this study are consistent with economic theories and previous empirical studies and provide valuable insights for policy makers to focus on promotion of technologies in all sectors of economy and develop human resources to boost economic growth. The negative relationship between FDI and economic growth in Pakistan also emphasizes the need to rationalize existing policies to attract FDI in productive fixed assets to reap long-term benefits of transfer of technology and capital investment rather than encouraging speculative investment in Government treasuries, bonds and stock market. Policymakers should also consider the recommendations of Krugman (1993), Hausmann and Fernández-Arias (2000) and Benetrix, Pallan, Panizza (2023), who observed that foreign capital flow enhances debt burden of host country and establish monopoly of multinational corporations. They advised that those countries, which have weak institutional framework, should avoid to invite foreign direct investment because it is harmful for them. The findings of this study also provide the same insight and recommends to avoid speculative type of foreign direct investment.

6. Conclusions

The empirical results reveal strong positive association between digital technologies and economic growth. These results emphasizes that the adoption of digital technologies in the business organizations can trigger economic growth and expand employment opportunities. The findings also highlight

significant and positive relationship between human capital and economic growth, emphasizing that policymakers should priorities and allocate maximum resources for education and health sectors to develop human resources, which are the key driver of growth in all sectors of economy. The negative association between FDI and economic growth indicates that Pakistan could not reap benefits from short-term foreign direct investment (FDI) due to law-and-order problem, terrorist activities and low-skilled workforce. Therefore, Pakistan should focus on improving law and order situation, controlling terrorist activities and enhancing labor skill through education and training. The skilled workforce does not only play effective role in economic growth in Pakistan but also earns high income if exports to other countries. Pakistan should also attract long term foreign direct investment in fixed capital assets. It is noted that mostly FDI poured in speculative activities like stock market for short term gain and is withdrawn without any notice, causing adverse fluctuations in the economy and negative impact on exchange rate. The policymakers should provide long-term FDI policy framework with attractive return to win the confidence of foreign investors as well as for overseas Pakistanis working in different countries.

6.1 Policy implications

The implications of the study on digital transformation in Pakistan are significant. It suggests that embracing digital technologies can lead to improved economic performance and human capital development. Organizations and individuals should prioritize digital transformation to stay competitive and drive innovation. The findings also emphasize the need for policies and initiatives that support digitalization efforts to maximize the benefits for the country's overall economic development. It also emphasizes the need for improvement of human capital because without the development

of human capital advanced technologies cannot be used and Pakistan cannot produce high-tech products and increase productivity.

6.2 Limitations and suggestions for further research

This study has some limitations, which include potential biases in the data collected, limitations in the sample size, and the generalizability of the findings to other contexts. Additionally, the study might not have omitted important variables that could impact economic growth. However, despite these limitations, the study delivers valued insights into the positive impact of digital transformation on financial performance and human capital development in Pakistan. However, positive relationship between BOP and economic growth needs further investigation.

In the light of these limitations, the following suggestions are made for further research:

Future research can explore the long-term effects of digital transformation in various sectors, examine government policies and barriers, and latest statistical methods to enhance the understanding of the relationship between digital transformation and its outcomes. The future research can also explore the long-term effects of digitalization on various sectors, such as education, healthcare, and government services. Additionally, it would be interesting to examine the part of government strategies in sponsoring digital transformation and a potential barrier faced by organizations and individuals in adopting digital technologies. Advanced data analysis techniques, such as causal inference methods, could also be employed to further understand the causal relationship between digital transformation, economic growth, and human capital development. The use of dataset having more than 20-year period can provide valuable insights about long term behavior of variables. Similarly, the

inclusion of more variables can make the results more robust and broader applicability.

Data Analysis

The data that used in this study will be made available on reasonable requests.

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Declaration of competing interests

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