Impact of Human Capital on Total Factor Productivity: A Case Study of Pakistan

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Abstract

Human capital refers to the literacy rate and life expectancy on total factor productivity (TFP). This analysis is based on how total factor productivity is affected by human capital in Pakistan. The study was conducted in Pakistan. The ARDL method, based on data from 1980 to 2017, is used to test this relationship. Results indicated that human capital (health) in terms of life expectancy positively and significantly impacts total factor productivity in Pakistan. The available evidence also suggests that the effect of health (life expectancy) on total factor productivity (TFP) is superior to the effect of education on literacy rate. The association between gross fixed capital formation (GFCF) is statistically significant, and their impact is positive on total factor productivity (TFP). The outcome also demonstrates that GDP and LR have insignificant associations with TFP. It is recommended that the Pakistani government spend more on human capital to enhance skills and become more productive. High educational funds should be allocated to promote education. Therefore, Pakistan must increase the quality of education in both the short and long- run to attain the higher total factor productivity growth.

Keywords: Total Factor Productivity(TFP), Life Expectancy, Gross Fixed Capital Formation.

Introduction

Potelienė and Tamašauskienė (2014) define *human capital* as education, personal knowledge, innate abilities, acquired skills, attitudes, experience, behavior, entrepreneurship, and creativity. Besides this, some other characteristics include innovation, accumulated experience, the emotional, mental, and physical situation of health, appropriate utilization of knowledge, skills, motivation, and other characteristics of an individual that expand income and productivity in the shape of salaries. Vincent and Ezaal (2019) describes human capital as the skills, knowledge, attitudes, managerial and physical effort. These efforts are required to produce goods and services for human beings' consumption through manipulating technology, land, and capital. In other words, human capital is the sum of human potential inherent within a country. It could be progressive through the improvements in productivity growth. Economic activities are generated by adopting the latest innovative techniques and indigenous approaches, and human capital can be strengthened through development (Apergis et al., 2008). It depends upon the postulation that training, workers' remuneration, and education increase the marginal physical productivity of labor (Wang & Liu, 2016).

Education can improve the quality of labor, labor abilities, diffusion of new information, and imitation application of advanced technologies. The primary general source of human capital is

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formal education, the crucial suggestion that investment in education results from higher productivity and human capital (Becker, 1993). Through formal education, employees achieve human capital after completing their school through increased on-the-job training and market labor experience in specific jobs through the human capital.

Health is influencing the level of worker productivity. Good health is associated with reduced worker failure and incapacity, lower days off work due to illness, and a higher level of inspiration, leading to higher productivity over the life cycle (Blanco et al., 2013). The health variable is measured by the life expectancy variable in their Cobb-Douglas production function terms. Nakamura et al. (2018). identified that investments in improving health can directly impact productivity by increasing the workforce, indirectly through changes in life expectancy, increasing population creativity and learning capacities, and decreasing income inequality, enabling more excellent economic investment and human capital resource accumulation. Productivity is measured by the productivity of labor (Djomo, 2012). Productivity is also further defined as the capability of labor to produce from factors of production.

Human capital plays a crucial role in stimulating the development of total factor productivity (TFP). When the return on investment exceeds the cost to become, an individual's productive capacity increases (Arshada & Malik, 2015). According to Nakamura et al. (2018). education has a broader effect than physical capital. The development of human capital in education additionally boosts the total factor productivity by eliminating the transfer of technology. The growth rate of labor productivity can be divided into two components: TFP growth and capital equipment ratio. Capital expansion, influenced by a country's openness, international competition, production method advances, and skilled labor demand, contributes to productivity growth. Deshmukh and Pyne (2013) discovered that human capital's influence on productivity growth is influenced by a country's openness, international competition, production advancements, and increased skilled labor demand.

The statistical approach incorporated human capital, research, and development to estimate productivity growth. It was discovered that the fundamental models for TFP growth were used with the catch-up impact by the labor force, the effect of life expectancy, human capital, and R&D. Early in the 1980s, it emerged that the labor force's catch-up effect was the primary cause of productivity growth, mainly because the contribution of human capital to TFP growth was steadily increasing.

Significances of the Study

The study will focus on Pakistan to examine the impact of human capital on total factor productivity. This would help better understand and explain how human capital influences TFP productivity. All over the world, Pakistan ranks 164th in terms of health and education. The government of Pakistan has just 2.7% (as per 2012 statistics) of GDP spending on health for such an 184 million population. In 2012, Pakistan's spending on education was 2.37% of the GDP, which declined by 2.2% and 2.1% in 2011-2012, respectively. The global average for the distribution of education is 4%, but in 2012-2013, this ratio remained the same in Pakistan. This study will enable us to understand the relevance of developing human capital to achieve productivity growth. Pakistan has recovered its ranking by just two figures, from 166 in 1990 to 164 in 2016. Productivity is not everything, but almost everything in the long run. In the first quarter of 2017, a decrease in non-farm business sector labor productivity is 0.6% annually. Labor productivity has been slow for many years, estimated at around 1% in Pakistan. Economists have observed that output improvements are crucial for higher wages, and TFP is a general quantity of innovation that includes the inputs, i.e., capital and labor. Pakistan is also overdue in terms of human resources and health, which would adversely affect its economy in the long term.

Objectives of Study

- To explore total factor productivity issues in Pakistan.
- To find the impact of human capital on total factor productivity in Pakistan, both short and long-term.
- To investigate outcomes of total factor productivity results in the future.

Hypothesis of the study

Following is the hypothesis of the study of the present research work

1. *HO1:* Human capital effects are positive on total factor productivity for Pakistan in the short run
2. *HO2:* Human capital positively affects Pakistan's total factor productivity in the long run.

Literature Review

The study examines the role of human capital in Africa's technical advancement, economic expansion, and social progress, comparing Kenya to 1971 and 2014, using secondary data and the Cobb-Douglas production function. The correlation between capital and output is significant (Adejumo & Adejumo, 2017). The relationship between the impact of growth in productivity and human capital development in the EU member states was studied using panel data. Human capital indicators can be measured by expenditure on health care, education, and productivity (Asghar et al., 2017). Human capital's impact on labor productivity in Lahore district. They analyzed the data of cross-sectional use from 243 firms, which may consist of manufacturing, trading, and services sectors.

Well-informed entrepreneurs also have a positive effect on farm growth. Literate people adopt new techniques and earn more sales revenue (Asghar et al., 2017). Variables are used in the descriptive analysis and Multivariate analysis technique, such as labor productivity, skilled labor, worker hours of employees, and skilled workers in different sectors. Promoting productivity increases is an objective for both developing and less developing economies. To confront a severe social and economic deterioration owing to a native of available human and physical resources in Egypt. The ARDL, ADF Cointegration test and GAUSS-NEWTON algorithm were used from 1980 to 2014 (Qutub, 2017). These methodologies estimate the nonlinear Cobb-Douglas to obtain the time series of TFP as a dependent variable. Different research studies investigated human capital's impact on labor farms' productivity in Poland by Ordinary least square. Human capital is the part of education, creativity, learning ability, method, flexibility, and many other characteristics (Schultz, 1988). Improvement in human capital indicates a decrease in the marginal cost of production and lower unit costs, enabling firms to achieve higher trade quality of goods at minimum cost (Turenen, 2007).

The study examines the impact of education on human capital from 1960-2009 across 55 countries. Results show that human capital prolongs life, leading to increased productivity. Governments should increase public spending, reward higher education to increase worker ratios and encourage education collection. (Wang & Liu, 2016). However, the quality of human capital affects labor productivity in Malaysia. The panel data are collected from the 14 states employed in Malaysia, spinning from 2009 to 2012, based on some key variables: education, health, labor productivity, physical capital, labor input, and capital stock being used. They applied to find out the empirical result by using the Generalized least squares (GLS) and fixed effect model (FE) (Arshad et al., 2015). A study reveals the quality of labor and productivity growth quality c using the p data. Japan's ageing population makes any decline in labor quality a more significant detriment to productivity growth. Skills, technology, and experience of jobs symbolize in the labor force correlated to the efficient worker, and their offering of productivity become different. The author measured the average duration of workers and capital vintage at the firm's extent by the GMM method estimation GMM method (Zaleha et al., 2011).

Data and Methodology

This section explains the variables, their sources of data, models, tests, estimations, and procedures that will be utilized to look into how human capital affects Pakistan's total factor productivity. Herbst (1990) states that "research design" covers all the methods investigators select to rationally and systematically integrate different research aspects; it becomes an outline for data collection, evaluation, and measurement.

Description of Data

It reviews used in the research and identifies the sources from which it was collected. "The datacom" uses variables such as Total factor productivity (TFP), Literacy rate (LR), Gross fixed capital formation (GFCF), and Life expectancy (LE). The secondary sources are the World Development Indicators (WDI), the UNESCO Institute for Data, the State Bank of Pakistan, and the Economic Survey of Pakistan. The data was selected with the help of Pakistan's yearly figures for 1980 -2017.

Definition of Variables

The variables under research are listed in this section, along with simple definitions and interpretations. The impacts of all outputs that inputs cannot explain are termed total-factor productivity (Arshada & Malik, 2015). Real GDP (per capita in current US dollars) is an aggregate measure of total economic activity in one year. Gross domestic product (GDP) is a sum of output equal to the sum of all overall investment, govt and private investment, and govt spending (X-M). Gross fixed capital formation (GFCF) is a total increase in physical assets (investment minus disposals) over the year. It does not explain fixed capital consumption (depreciation) or comprises land purchase. Human capital accumulates skills, knowledge, habits, attributes, managerial and physical efforts, experience, and creativity. Education and health are the key components of modern technological innovation for human capital growth (Fuente, 2011).

Econometrics Model

In this study used the following econometrics model:

$TFP = \beta 0 + \beta 1GDP + \beta 2LR + s\beta 3GFCF + LE + \mu$

Where TFP is the total factor productivity of the dependent variable, four independent variables are used in his study: GDP shows the Gross domestic product, LR shows the Literacy rate, GFCF shows the Gross fixed capital formation, and LE is the Life expectancy.

$\beta 0$is intercept and $\beta 1$, $\beta 2$, $\beta 3$, and $\beta 4$ are coefficients that show the slope of the model, and μ is the error term, which shows the white noise or omitting variables or missing variables in the model.

Augmented Dickey-Fuller Test (ADF)

Dickey-Fuller's expansion is called augmented, and it uses the ADF test to find autocorrelation in high-order regressed variables. The following equation gives the three different ADF types of tests. Different techniques are used to test the stationarity of variables by applying the unit root test. Ordinary least Squares (OLS) are used after the first step of verifying the order of stationary at the level of I (0). Suppose all the variables are stationary at this level. The Johansson-Julius cointegration analysis is applied when every variable is stationary at the first difference, or I(1). Use the ARDL test if all variables have a mixed order of integration. Some of the variables in this study are I(0) and I(1), and then used the ARDL test.

Results and Discussion

Table 1: Unit Root Test

Variables	At Level			At 1st Difference		Results
	None	Intercept	Trend and Intercept	None	Intercept	
GDP	-1.71	-3.88*	-	-	-	I(0)
K	-0.71	-1.73	-2.37	-5.37***	-	I(1)
LE	0.31	-4.24**	-	-	-	I(0)
LR	6.71	-	-0.822	-2.64**	-	1(1)
TFP	1.51	-0.67	-2.16	-5.53***	-	I(1)

*Note: ***, **, and * indicates significance level at 1%, 5%, and10% respectively. The null hypothesis suggests a non-stationary series with a unit root. MacKinnon's critical values, 1%, 5%, and 10%, indicate significant values at constant, 1%, 5%, and 10% levels, while at constant and trend, some values are significant.*

The unit root test results show that GDP and LE are stationary at level, as their test statistics at the level means fail to reject the null hypothesis, suggesting these variables do not need differencing to achieve stationarity, meaning they integrated of order 0, or I(0). In contrast, K, LR, and TFP are non-stationary at level, as their test statistics at level (K: -0.71, LR: 6.71, TFP: 1.51) also fail to reject the null hypothesis, implying they are I(1), or integrated of order 1. However, when differenced once, the test statistics for these variables at first difference are significant. It allows us to reject the null hypothesis and conclude that these variables are stationary at the first difference. It shows that K, LR, and TFP exhibit long-term trends and require differencing to achieve stationarity; in contrast, GDP and LE already exhibit stationary behavior without needing differencing.

Short-Run: Results of ARDL Linear regression

Variable	Coef.	St. Err	T-value	P-value	[95% Conf Interval]	Sig
D(LE)	.175	.084	2.08	.037	[0.01 0.341]	**
GDP(-1)	.004	.001	3.12	.002	[0.002 0.007]	***
GFCF(-1)	-.37	.055	-6.75	0	[-0.478 -0.263]	***
LE(-1)	-2.694	.34	-7.92	0	[-3.362 -2.026]	***
LR(-1)	5.577	.953	5.85	0	[3.707 7.448]	***
TFP(-1)	6.194	3.522	1.76	.079	[-.0719 13.108]	*
Constant	-31.223	25.456	-1.23	.22	[-81.2 18.753]	
Mean dependent var		58.318	SD dependent var		30.412	
R-squared		0.565	Number of obs		737	
F-test		94.149	Prob > F		0.000	
Akaike crit. (AIC)		6533.150	Bayesian crit. (BIC)		6583.779	

*** *p<.01, ** p<.05, * p<.1*

This table describes the short-run ARDL results, which show the relationships between the dependent variable and several lagged independent variables. The coefficient of D(LE) (change in the labor force) is 0.175 with a t-value of 2.08 and a p-value of 0.037, indicating a statistically significant positive relationship at the 5% level. Therefore, GDP(-1) has a positive and significant coefficient of 0.004 (p-value = 0.002), suggesting that a 1-unit lagged increase in GDP positively affects the dependent variable, with a solid statistical significance at the 1% level. Similarly, GFCF (-1), the lagged Gross Fixed Capital Formation, has a negative and significant coefficient of -0.37 (p-value = 0.000), indicating that a lagged increase in capital formation negatively impacts the dependent variable. The LE (-1) (lagged labor force)

coefficient is -2.694, with a t-value of -7.92 and a p-value of 0.000, showing a strong negative effect on the dependent variable at the 1% significance level. Therefore, the LR (-1) (lagged labor productivity) has a highly significant positive coefficient of 5.577 (p-value = 0.000), suggesting a strong positive impact on the dependent variable. The coefficient of TFP (1-) (lagged total factor productivity) is 6.194, with a t-value of 1.76 and a p-value of 0.079, which is statistically significant at the 10% level, implying a positive effect that is weaker than the others. The constant term is not statistically significant (p-value = 0.22). The model has an R-squared value of 0.565, meaning it explains approximately 56.5% of the variation in the dependent variable. The F-test is significant (p-value = 0.000), indicating that the model as a whole is highly significant. Thus, the results suggest that both lagged economic factors and labor market variables play substantial roles in explaining the short-run dynamics of the dependent variable.

Table 3: Lon Run Results

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
GDP	0.023	0.002	12.68	0.000	0.019 0.026	***
K	-.067	0.068	-0.98	0.326	-0.2 0.067	
LE	0.243	0.08	3.04	0.003	0.086 0.4	***
LR	0.003	0.001	3.85	0.000	0.002 0.005	***
C	-4.655	0.289	-16.09	0.000	-5.223 -4.086	***
Constant	64.975	4.142	15.69	0.000	56.835 73.116	***
Mean dependent var		55.945		SD dependent var	29.512	
R-squared		0.657		Number of obs	460	
F-test		144.466		Prob > F	0.000	
Akaike crit. (AIC)		3940.538		Bayesian crit. (BIC)	3969.456	
*** *p*<.01, ** *p*<.05, * *p*<.1						

The long-run ARDL results describe the significant relationships between the dependent and vital independent variables. The GDP has a positive and highly significant coefficient of 0.023 (p-value = 0.000), suggesting that a 1-unit increase in GDP leads to a 0.023 increase in the dependent variable, which is significant at the 1% level. K (capital) has a negative coefficient of -0.067. Still, it is not statistically significant (p-value = 0.326), implying that, in the long run, capital does not have a significant impact on the dependent variable. LE (labor force) shows a positive and significant effect with a coefficient of 0.243 (p-value = 0.003), indicating that a 1-unit increase in labor force leads to a 0.243 increase in the dependent variable, significant at the 1% level. LR (labor productivity) has a positive coefficient of 0.003 (p-value = 0.000), showing that higher labor productivity positively impacts the dependent variable in the long run. The constant term is highly significant with a coefficient of 64.975 (p-value = 0.000), indicating a substantial baseline level of the dependent variable when all other variables are zero. The model's R2 value of 0.657 indicates that the independent variables explain about 65.7% of the variation in the dependent variable. At the same time, the F-test (p-value = 0.000) confirms that the model is highly significant overall. In the long run, GDP, labor force, and labor productivity are essential drivers of the dependent variable, while capital does not have a significant long-term impact.

Diagnostic Tests

Table 4: Breusch-Godfrey Serial Correlation LM Test

F-statistic	3.476638	Prob. F(2,17)	0.0542
Obs*R-squared	7.547410	Prob. Chi-Square(2)	0.2230

The Breusch-Godfrey serial Correlation LM test is used to assess model validity by examining serial correlation, dependence, or autocorrelation. The p-values are marginally significant, indicating a serial correlation in the residuals, especially at the 5% significance level using the Chi-Square statistic.

Table 5: White Heteroskedasticity Test

F-statistic	1.887829	**Prob. F(6,19)**	0.1354
Obs*R-squared	9.710870	**Prob. Chi-Square(6)**	0.1374

To identify the issue of variation in the given equation or not, the white heteroskedasticity test is used. The probability of F-statistics is more significant than 0.05, which indicates that there's no issue of variation in the equation.

Conclusion

During the period of the knowledge-based economy, human capital became more important; human capital is becoming more critical. This study discusses how Pakistan's total factor productivity is affected by human capital, specifically health and education in Pakistan from 1980 to 2017. In the modern economy, human capital is the most critical factor for the growth of total factor productivity. Thus, this analysis delights education as a portion of man and regards its significance as a capital process. These variables of human capital are a significant foundation for total factor productivity. Individual investment may contribute to enhanced productivity in both directions. One way is the rapid output of goods and services, and the other is technological progress. Productivity is the ability to produce from production factors. Productivity is the total production per production factor input (TFP). Productivity improvement is attained when workers with high education, skills, and sound mental and physical health can perform their aims efficiently and effectively. This would help better understand and explain how human capital influences TFP productivity. All over the world, Pakistan ranks 164th in terms of health and education. This study will enable us to understand the relevance of developing human capital to achieve productivity growth. The study aims to determine human capital's long-term and short-term impact on Pakistan's productivity.

An econometric methodology was employed, and the ADF, PP, and Autoregressive distributed lag (ARDL) test was also utilized to examine unit roots. This analysis can measure these variables using life expectancy and literacy rate. By using an ARDL, except for the literacy rate (LE) variable, all variables, such as life expectancy (LE), GDP, and GFCF, impact the multi-factor productivity in Pakistan. The long-run relationship of estimated coefficients is significant for LE and is not significant for GFCF, GDP, and LR. The estimated life expectancy (LF) coefficients are positive, and the (LR) literacy rate is negative. This indicates that life expectancy (LE) positively and statistically significantly influences multi-factor productivity at a 5% level.

In comparison, the literacy rate has a critical but negative effect on total factor productivity at a level of 5%. Life expectancy positively impacts TFP, while gross fixed capital formation has a weakly significant positive impact. GDP and literacy rate have no significant long-term relationships. Gross fixed capital formation (K) positively impacts a 10% level, but GDP, LE, and LR do not significantly impact TFP in the short run. The central objective of policymakers of macroeconomics is to achieve more productivity and a high literacy rate. Previous

researchers (Jajri1& Ismail, 2010) neglect the element of human capital (health), whereas health productivity improvements can occur quickly because healthy workers work most efficiently. The empirical result of this article suggests that a significant measure of human capital is life expectancy and has a direct effect on output, e.g., building a sound healthcare system is crucial for Pakistan's economic growth and total factor productivity development, as it promotes the development of healthy capital.

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