



# Human Capital and Labour Productivity: Empirical Evidence from Developing Countries

Mohamed Fathy Abdelgany\*, Amira Abdelmoez Saleh

Economics Department, Faculty of Politics and Economics, Beni-Suef University, Beni Suef, Egypt

## Email address:

[mfathy@eps.bsu.edu.eg](mailto:mfathy@eps.bsu.edu.eg) (M. F. Abdelgany), [amira.ab@eps.bsu.edu.eg](mailto:amira.ab@eps.bsu.edu.eg) (A. A. Saleh)

\*Corresponding author

## To cite this article:

Mohamed Fathy Abdelgany, Amira Abdelmoez Saleh. Human Capital and Labour Productivity: Empirical Evidence from Developing Countries. *International Journal of Economics, Finance and Management Sciences*. Vol. 10, No. 4, 2022, pp. 173-184.

doi: 10.11648/j.ijefm.20221004.13

Received: June 22, 2022; Accepted: July 9, 2022; Published: July 18, 2022

---

**Abstract:** Human capital is the main driving force of labour productivity. Thus, this study aims to investigate the impact of both education and health as crucial dimensions of human capital on labour productivity in 39 developing countries. To achieve this objective, the study employs a dynamic Generalized Method of Moment (GMM) estimator on panel data from 2000 to 2019. This study utilizes two separate models. The first model focuses on estimating the effect of education on labour productivity. While the second one focuses assessing on the effect of health status on labour productivity and the study examines both models through three separate steps. The findings reveal that education positively and significantly affects labour productivity. Also, the correlation between health status and labour productivity is statistically significant and positive. Additionally, the study shows that physical capital, trade openness, inflation, and the level of advanced technology are meaningful determinants of labour productivity in developing countries. These results are in line with economic theory and many empirical studies. Furthermore, the results show that education has a more significant impact on labour productivity than health. The study suggests that policymakers in developing countries should target primary education as an approach to increase labour productivity and adopt appropriate measures to enhance workers' health.

**Keywords:** Labour Productivity, Human Capital, Education, Health, Dynamic GMM Estimator, Developing Countries

---

## 1. Introduction

With the increase of global competition, the importance of increasing productivity is recognized. It is argued that at the micro-level, increasing productivity is the main factor in increasing the profitability and competitiveness of a firm or a sector. While at the macro-level, increasing productivity will lead to increase revenues of the state which can enable countries to provide more services to improve the living standards of their citizens [1]. Many economists agreed that productivity is the key factor of economic growth in both developing and developed countries, a key indicator of economic performance, and an important indicator of economic welfare.

There are many measures of productivity, but the most common measure is labour productivity. Labour productivity is the gross domestic product per person employed. In addition, labour productivity can be measured

by output per hour worked, but this measure suffers from many statistical problems. So, measuring productivity as the output per person employed is the most popular measure of productivity [2].

Productivity in developing countries is lower than in developed ones (see figure 1), and this is the main cause of the divergence of per capita income among them [3]. Thus, low labour productivity is one of the most important challenges that face developing countries. So, analyzing and exploring the driving forces of labour productivity is very essential, especially for developing countries.

Endogenous growth theory considers human capital as the driving force of labour productivity [4]. And it considers education and health as the two crucial dimensions of improving human capital and then labour productivity [5]. It assumes that people, societies, and countries can achieve economic benefits through investment in people through education, training, and health. As this can increase people's

skills and knowledge which will reflect positively on their productivity.

Thus, by using panel data of 39 developing countries over the period 2000-2019 and applying the GMM estimator, the study aims to examine the impact of human capital on labour productivity. Our theoretical approach is based on the Cobb-Douglas production function which considers human capital

as the main source of improving productivity.

The rest of the study is organized as follows, Section 2 outlines the literature review that addressed the relationship between human capital and labour productivity at the micro and macro levels, Section 3 presents the Methodology, Section 4 includes the estimation results, and the last section includes research conclusion and recommendations.

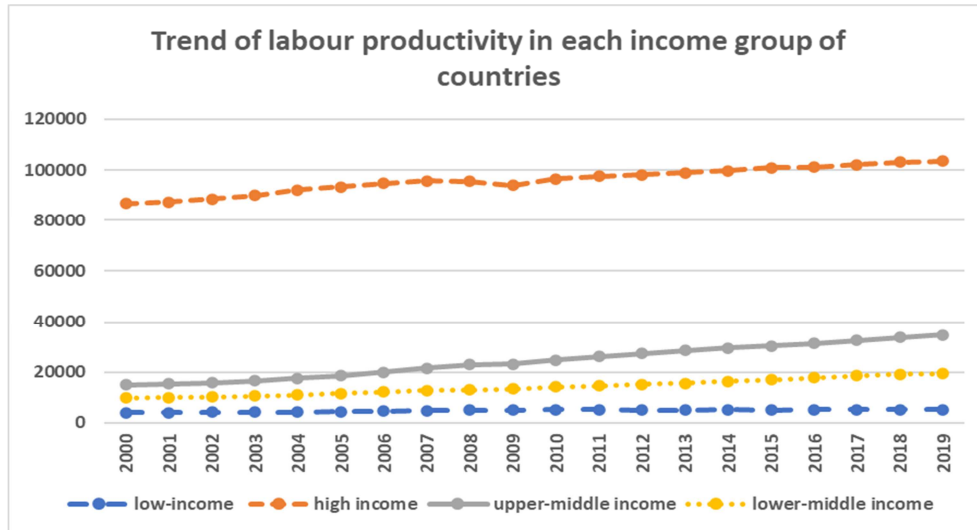


Figure 1. Labour productivity trend in each income group of countries.

## 2. Literature Review

Many theoretical studies analyzed the importance of human capital in improving labour productivity. A study by Cörvers [6] found that education has four effects on productivity: the worker effect, the diffusion effect, the allocative effect, and the research effect. First, the worker effect refers to workers with a higher level of education are supposed to be more effective in using resources, and they can produce more output by using available resources. Therefore, workers who have a higher level of education can increase productivity and shift the production possibility curve outwards. Second, the diffusion effect emphasizes that workers with a higher level of education are more able to keep up with technological change and can introduce new production techniques faster, and this will lead to higher productivity growth. Third, the allocative effect refers to the higher efficiency of well-educated workers in allocating all factors of input in the production process between the alternative uses. Fourth, the research effect indicates that higher education has an important role in research and development activities, and according to the endogenous growth model, research and development R&D are considered the main factors for technological progress and productivity growth.

In addition, studies made by Šniukiene & Matuzeviciute [7], Saif Ullah, et al [8], and Siddique, et al [9] showed that health can affect labour productivity through many channels: First, healthier people are more active and they can work for

more hours which reflect positively on their productivity. Second, good health is one of the main sources of capital accumulation, as increasing life expectancy encourages people to save and invest which leads to higher productivity growth. Third, Health can affect labour productivity through education as workers with better health can learn and innovate which leads to an increase in their productivity. Fourth, improved health leads to enhance productivity by allowing more time for workers to specialize in their work.

Empirical studies that addressed the relationship between human capital and labour productivity can be divided into micro and macro-level studies. According to micro-level analysis, many studies used education only as a proxy for human capital. For instance, a study by Razzak & Timmins [10] showed that workers with high qualifications affect positively labour productivity. A study by Nowak & Kijek [11] investigated the relationship between human capital and labour productivity of farms in Poland in 2012. The authors used the level of education of managers to express human capital. The study concluded that productivity is higher for all farms whose managers have completed higher education than for farms whose managers have not completed such education. Rukumnuaykit & Pholphirul [12] indicated a strong correlation between higher education and labour productivity in the Thai manufacturing sector. Similarly, by using firm-level data, studies by Arvanitis & Loukis [13], Afroz [14], Lottum & Zanden [15], and Asghar, et al [16] found that education has a positive and significant impact on labour productivity.

According to macro-level studies, some studies used

education only as a proxy for human capital. For example, Chansarn [17] by using a sample of 30 countries, the study showed that education is the most important determinant of labour productivity over the period (1981-2005). Olimpia [18] by using a sample of 22 European countries over the period (1996-2010), the study found that labour productivity is positively and strongly associated with human capital stock (measured by the level of educational attainment). Abdul Rehman & Mughal [19] analyzed the impact of technical education on labour productivity in Pakistan during the period (1990-2011). The study found that skilled workers can enhance labour productivity positively and unskilled workers affect negatively labour productivity. Máté, et al [20] by using a sample of 25 OECD countries, the study indicated a strong association between education and productivity during the period (2000-2011).

In addition, some studies used health only as a proxy for human capital. For instance, Bloom, et al [21] by using a sample of countries, found that health has a positive and significant impact on labour productivity. Ugwu & Suleiman [22] showed the effect of human health on labour productivity in Nigeria. The study found that healthy workers are one of the determinants of productivity growth in Nigeria. Saif Ullah, et al [8] investigated the impact of human health on labour productivity in Pakistan during the period (1980-2010). The study found that life expectancy has a positive but insignificant impact on labour productivity.

Some studies used both health and education as proxies for human capital. For instance, Umoru & Yaqub [23] showed that investment in health and education has a positive and significant impact on productivity in Nigeria. Arshad & Ab Malik [24] by using panel data for 14 states in Malaysia, showed that healthier and more educated workers have higher productivity. Šniukiene & Matuzeviciute [7] found that expenditure on education and life expectancy have a positive impact on labour productivity in EU countries. LE, et al [25] showed that human capital index has a positive and significant impact on labour productivity in Vietnam over the period (1986-2014).

A few empirical studies focused on developing countries, for example, Siddique, et al [9] showed the impact of human health on labour productivity in 75 middle-income countries using two proxies for human health (life expectancy and undernourishment). It concluded that life expectancy has a positive impact on labour productivity while undernourishment has a negative impact on labour productivity. Hassan, et al [26] found that expenditure on health has a positive but insignificant impact on labour productivity in African countries over the period (2002-2011).

Thus, there are many empirical studies that examined the impact of human capital on labour productivity at the micro-level. But there is a lack of studies that addressed this impact at the macro-level. In addition, there is a lack of studies that focused on developing countries. So, this study aims to reduce the gap of studies by addressing the impact of human capital on productivity in developing countries by using a

sample of 39 developing countries during the period (2000-2019). The study uses two proxies for human capital: education and health. It introduces school enrollment in primary education as a proxy for education, and life expectancy as a proxy for health.

### 3. Methodology

#### 3.1. Theoretical Background

To investigate the impact of human capital on labour productivity, the study uses the cobb-Douglas production function. The function form has commonly been used by many previous empirical studies such as studies of Keesookpun & Mitomo [27] and Arshad & Ab Malik [24].

$$Y_t = K_t^\alpha L_t^\beta A_t \quad (1)$$

Y is total output, K is physical capital, L is the total labour force, A is the level of advanced technology, t is the time trend,  $\alpha$  and  $\beta$  express the proportion of capital and labour in total output.

Lucas criticized this equation as it considers L as homogenous, and it doesn't take into account the quality of work which can be measured by human capital as it is one of the main determinants of economic growth [28].

So, according to Locus, the production function can be written as:

$$Y_t = K_t^\alpha L_t^\beta H_t^{1-\alpha-\beta} A_t \quad (2)$$

where  $\alpha + \beta + (1-\alpha-\beta) = 1$  (maintain the assumption of constant returns to scale), K is capital input, L is labour input, H is human capital, and A expresses the efficiency of using inputs to produce outputs.  $\alpha$ ,  $\beta$ , and  $(1-\alpha-\beta)$  represent the contribution of physical capital, labour, and human capital to total output.

Following Umoru & Yaqub [23] and Yousef [29], to calculate labour productivity, both sides of equation (2) are divided by  $L_t$  and the equation can be written as:

$$\frac{Y_t}{L_t} = \frac{K_t^\alpha L_t^\beta H_t^{1-\alpha-\beta} A_t}{L_t} \quad (3)$$

Equation (3) can be written as:

$$\frac{Y_t}{L_t} = \frac{1}{L_t} \frac{K_t^\alpha}{L_t^\alpha} \frac{L_t^\beta}{L_t^\beta} \frac{H_t^{1-\alpha-\beta}}{L_t^{1-\alpha-\beta}} A_t \quad (4)$$

$$\frac{Y_t}{L_t} = \frac{1}{L_t^{1-\alpha-\beta-1+\alpha+\beta}} \left(\frac{K_t}{L_t}\right)^\alpha \left(\frac{H_t}{L_t}\right)^{1-\alpha-\beta} A_t \quad (5)$$

$$\frac{Y_t}{L_t} = \left(\frac{K_t}{L_t}\right)^\alpha \left(\frac{H_t}{L_t}\right)^{1-\alpha-\beta} A_t \quad (6)$$

where GDP per worker ( $\frac{Y_t}{L_t}$ ) represents labour productivity (LP), and it is a function of physical capital per unit of labour ( $\frac{K_t}{L_t}$ ) $^\alpha$ , human capital per unit of labour ( $\frac{H_t}{L_t}$ ) $^{1-\alpha-\beta}$ , and A is total factor productivity and it is measured by the level of advanced technology of the country.

Taking natural Log from equation 6:

$$\text{Log } LP = \alpha \text{Log } K + (1 - \alpha - \beta) \text{Log } H + \text{Log } A \quad (7)$$

The study adopts equation (7) at the macro-level as the fundamental equation of the study. It outlines that physical capital, human capital, and the level of advanced technology are the main determinants of labour productivity.

After adding other explanatory variables which can affect labour productivity, the equation will become:

$$\text{Log } LP = \alpha \text{Log } K + \beta_1 \text{Log } H + \beta_2 \text{Log } A + \beta_3 \text{Log } Z \quad (8)$$

where z is other variables that can affect labour productivity.

### 3.2. Data

To examine the impact of human capital on labour productivity, the study uses a panel data model for 39 developing countries (6 low-income countries, 16 Lower-middle income countries, and 17 upper-middle income countries) (see Table 1 for the sample of countries in the study). The choice of countries depends on the availability of data. The study uses secondary data resources available from the World Bank, International Monetary Fund (IMF), the International Labour Organization (ILO), and the International Telecommunication Union (ITU). (Table 2 shows the description of the variables used in the study, the source of data, and their abbreviation).

The dependent variable is GDP per worker Log (LP), which is used as a proxy for labour productivity. The study uses two dimensions of human capital: education and health. Following Deme & Mahmoud [30] the study uses school enrollment in primary education (millions) as a proxy for education. And following Umoru & Yaqub [23], Saif Ullah,

et al [8], and Siddique, et al. [9] the study uses life expectancy as a proxy for health. Also, following the previous empirical studies, the study uses four control variables. Following Tpeski, et al [31] and Dua & Garg [32] the study uses gross fixed capital formation as a proxy for physical capital, and this indicator is expected to influence positively on labour productivity. Also, the study uses a trade openness indicator, and it is expected to influence positively labour productivity [33, 34]. Inflation is expected to influence negatively labour productivity [35, 36]. Finally, following Mačiulytė-Šniukienė & Gaile-Sarkane [37] and Kurt & Kurt [38], the study uses the number of internet users as a proxy for advanced technology and it is expected to influence positively labour productivity.

**Table 1.** List of developing countries in the study.

Low-income countries	Lower-middle income countries	Upper-middle income countries
	Bolivia	Albania
	Cambodia	Armenia
	Cameroon	Brazil
	Egypt	Colombia
	El Salvador	Costa Rica
	Ghana	Ecuador
Burkina Faso	India	Georgia
Burundi	Indonesia	Guatemala
Mali	Morocco	Jamaica
Niger	Nepal	Jordan
Rwanda	Nigeria	Kazakhstan
Togo	Senegal	Malaysia
	Sri Lanka	Mexico
	Tanzania	Panama
	Tunisia	Peru
	Vietnam	South Africa
		Thailand

**Table 2.** Description of dependent, independent, and instrumental variables.

Variable	Description	Abbreviation
GDP per person employed.	Dividing gross domestic product by the number of workers.	LP
Enrollment in primary education	Total number of pupils (both sexes) enrolled in primary education.	ED
Life expectancy	Life expectancy at birth in years.	HE
Physical capital	Gross fixed capital formation (as a percentage of GDP).	PHC
Trade openness	The sum of exports and imports as a percentage of GDP.	Open
Inflation	Measured by consumer price index (annual percentage change).	Inf
Technology	Measured by the number of internet users as a percentage of the total population.	Tech
Exports from information -communication technology	Exports from information - communication technology (% of total exports).	ICT
Foreign direct investment (% GDP)	Net inflow of foreign direct investment as a percentage of GDP.	FDI

Table 3 shows descriptive statistics of variables included in the study. The table shows the mean, median, standard deviation, minimum value, maximum value, and the total number of observations of all variables. The statistics report that the average value of Log (LP) in the selected sample of developing nations is 9.61\$ with a minimum value of 7.47\$ and a maximum value of 11.11\$. While the average value of Log (ED) in the selected sample of countries is 14.72 with a minimum and maximum value of 11.53 and 18.79, respectively. The mean value of Log (HE) is 4.20

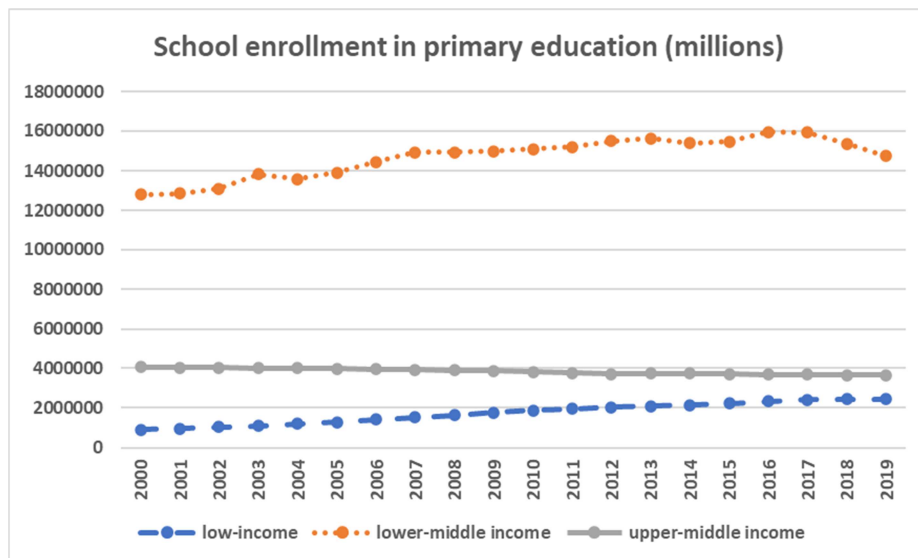
years with a minimum and maximum value of 3.83 and 4.38, respectively. The mean value of gross fixed capital formulation is 3.07% with a minimum value of 1.02% and a maximum value of 3.70%. Then, the mean, minimum, and maximum values of Log trade openness (Open) are 4.15%, 3.03%, and 5.39% respectively. Log (Inf) has a mean value of 1.34 with a minimum and maximum value of -3.20 and 3.62 respectively. Finally, the average value of Log (Tech) is 2.19% with a minimum value of -3.31% and a maximum value of 4.43%.

**Table 3.** Descriptive statistics: LP, ED, HE, PHC, Open, Inf, Tech.

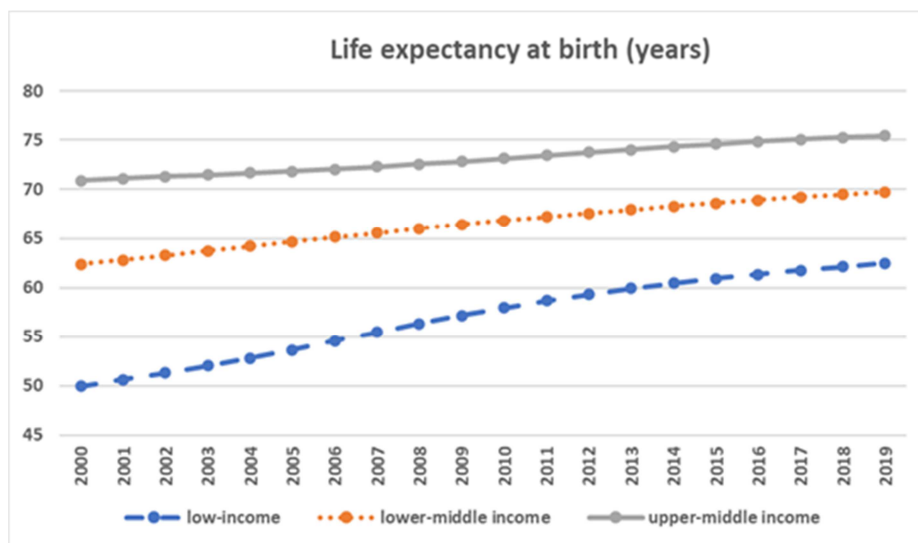
39 Developing countries						
	Mean	Median	St. Dev	Minimum	Maximum	Obs
Log (LP)	9.61	9.85	0.913	7.47	11.11	780
Log (ED)	14.72	14.64	1.40	11.53	18.79	780
Log (HE)	4.20	4.25	0.128	3.83	4.38	780
Log (PHC)	3.07	3.07	0.277	1.022	3.70	780
Log (Open)	4.15	4.12	0.46	3.03	5.39	780
Log (Inf)	1.34	1.45	0.94	-3.20	3.62	737
Log (Tech)	2.19	2.56	1.68	-3.31	4.43	780

Figure 2 shows the time series trend of school enrollment in primary education during the period (2000-2019). The study divides the sample according to income group classification. For the selected sample of low-income countries, gradually people became more educated, as the number of students enrolled in primary education rose dramatically by 167.61% from 916597 million in 2000 to 2452949 million in 2019. For the

sample of lower-middle-income countries, enrollment in primary education rose by 15.10%. As it rose from 12802662.63 million in 2000 to 14736926.06 million in 2019. For the selected sample of upper-middle-income countries, during the period 2000-2019, the number of students enrolled in primary education declined slightly by 10.03%. As it declined from 4053817 million in 2000 to 3647004 million in 2019.



**Figure 2.** School enrollment in primary education.



**Figure 3.** Life expectancy at birth.

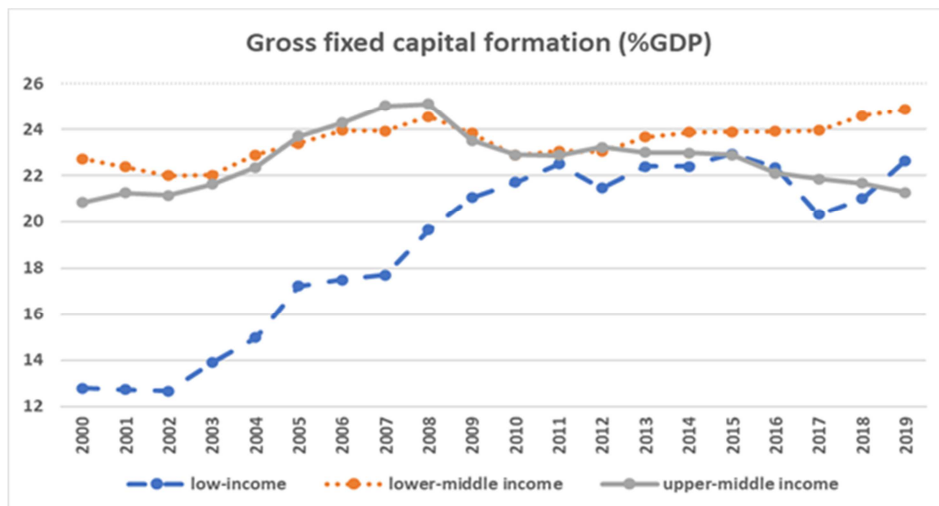


Figure 4. Gross fixed capital formation (% GDP).

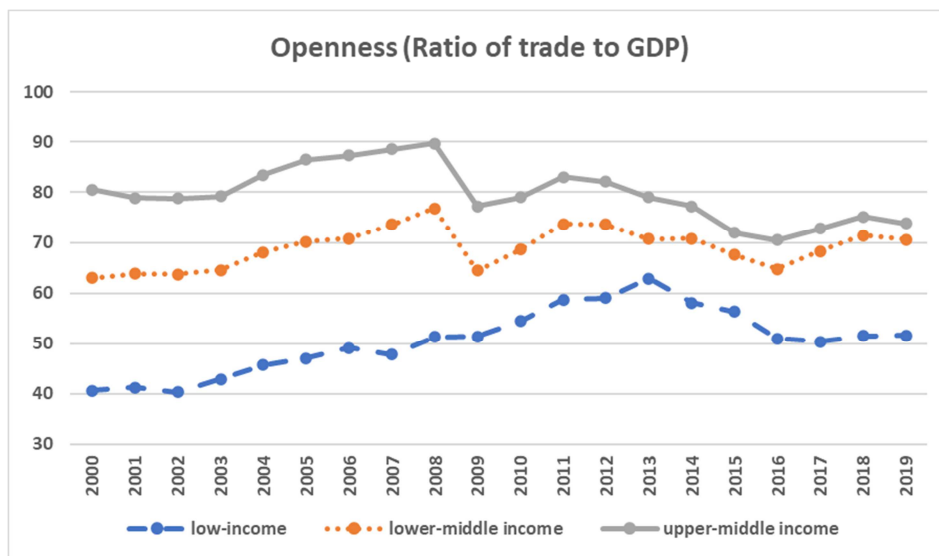


Figure 5. Openness (ratio of trade to GDP).

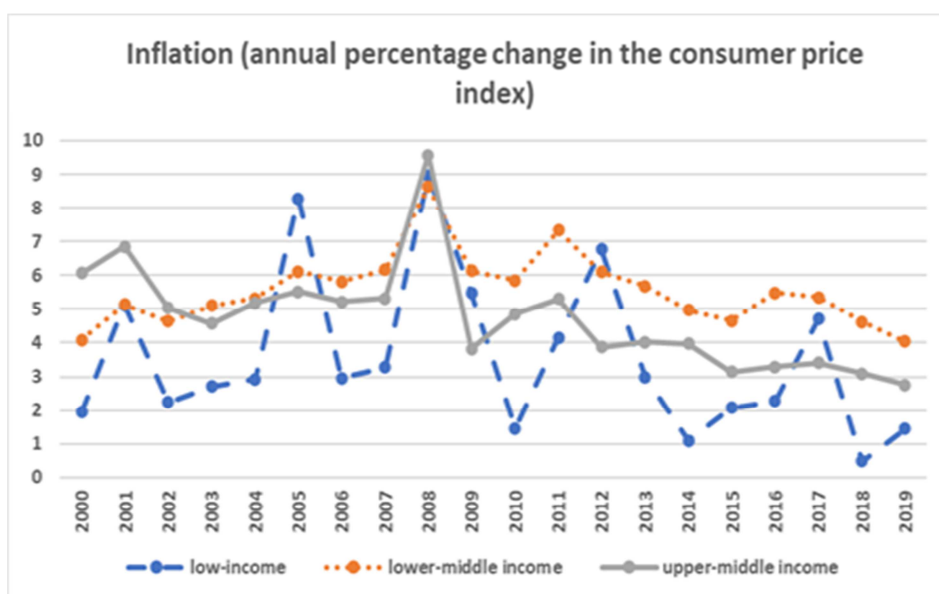


Figure 6. Inflation rate.

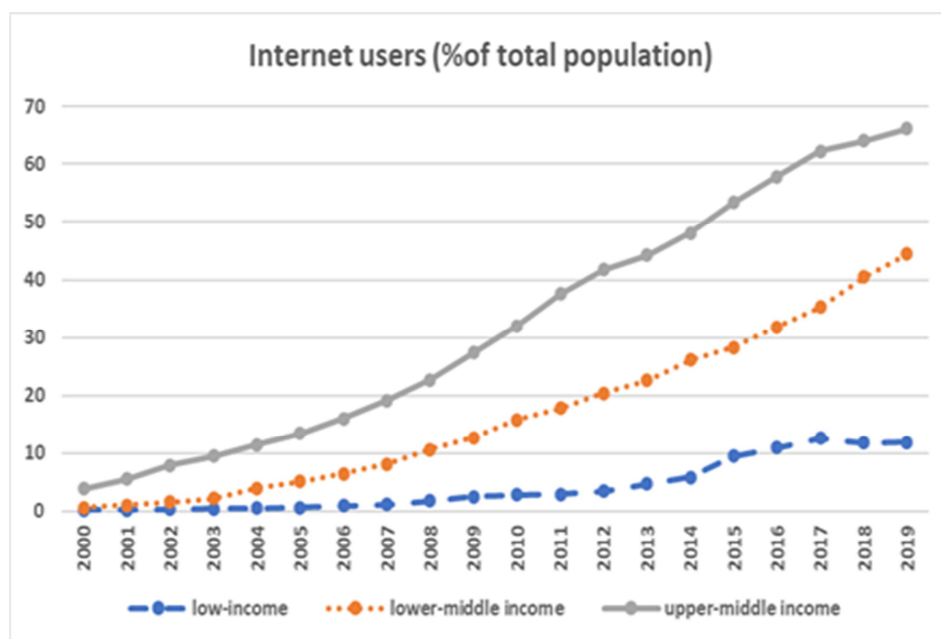


Figure 7. Number of internet users (% of total population).

Figure 3 shows that during the 2000-2019 period, life expectancy rose gradually from 49.95 years to 62.49 years for the sample of low-income countries, from 62.37 years to 69.75 years for the sample of lower-middle-income countries, and from 70.91 years to 75.44 years for the selected sample of upper-middle- income countries. Thus, each income group of developing countries has achieved a remarkable increase in life expectancy, and this can be attributed to increasing income per capita in developing countries that enabled people to invest in health, increasing the government's efforts to improve the health sector, and increasing the level of education of citizens. Also, Figures 4, 5, 6, and 7 show the time series trend of other

variables used in the study.

The two scatter Plots in figures 8 and 9 show the relationship between productivity and human capital variables (school enrollment in primary education and health) over the period (2000-2019). Figure 8 indicates a positive but weak correlation between productivity and school enrollment in primary education (India, Panama, Albania, and Armenia are outliers). In addition, figure 9 shows a positive and weak relationship between life expectancy and productivity.

In general, the scatter plots indicate the positive association between productivity and human capital variables.

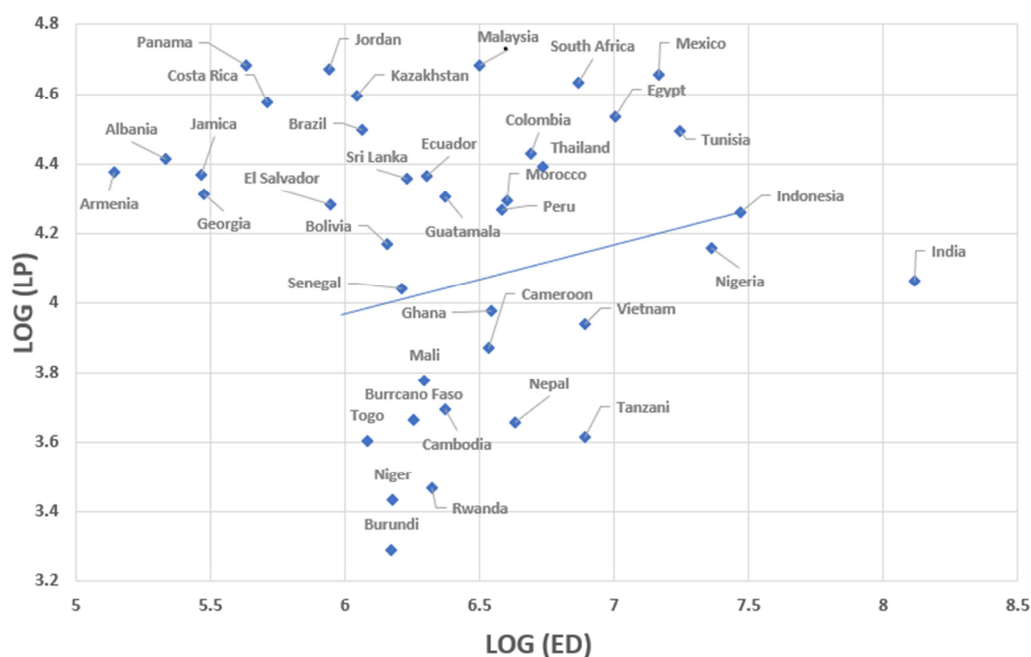


Figure 8. Correlation between Log (ED) and Log (LP).



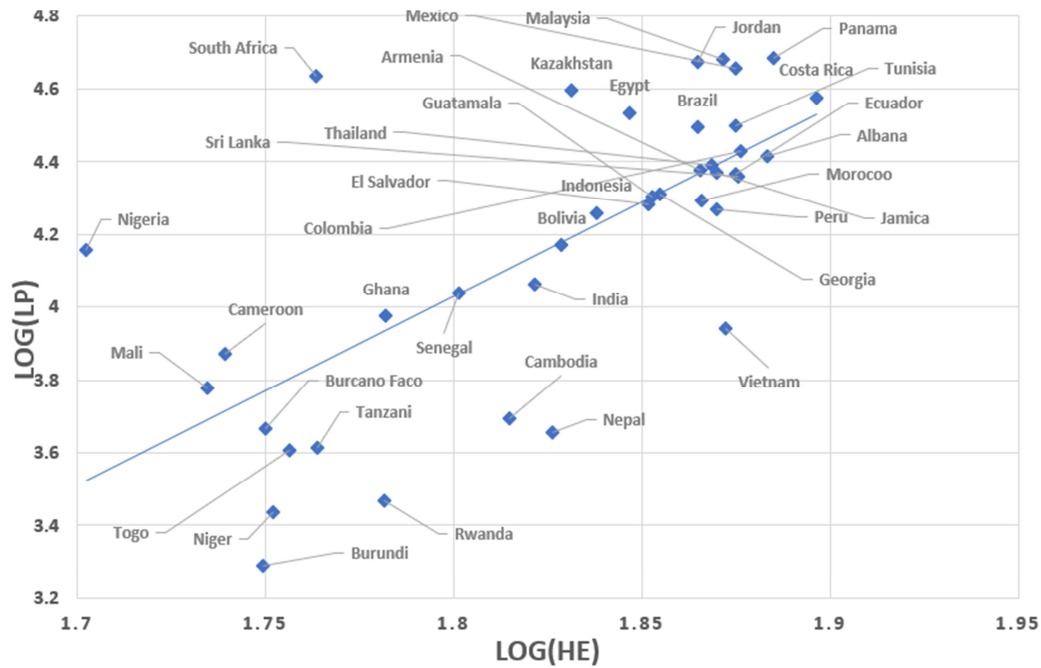


Figure 9. Correlation between Log (HE) and Log (LP).

### 3.3. Empirical Model

To investigate the impact of human capital on labour productivity by using panel data of 39 developing countries, the study uses school enrollment in primary education and life expectancy as two proxies for human capital. The study applies a dynamic GMM estimator to capture the endogeneity problem. As two steps should be applied: Firstly, the first difference should be taken to eliminate biases resulting from unobserved country-specific effects. Secondly, lagged independent and exogenous variables are used as instrumental variables to eliminate the correlation between

the error term and the dependent variable [39]. Two diagnostic tests should be used to determine the validity of the GMM estimator. The first one is the Sargan test which determines the validity of instrumental variables and the second one is the Arellano and Bond test which clarifies if there is autocorrelation in the error term.

The study expects the two proxies of human capital are correlated. So, the study will estimate two models using one proxy of human capital in each of them. Thus, to estimate the impact of human capital on labour productivity in 39 developing countries, the study will use the following specification of the models:

$$\text{Log } LP_{it} = \beta_1 \text{Log } LP_{it-1} + \beta_2 \text{Log } ED_{it} + \beta_3 \text{Log } PHC_{it} + \beta_4 \text{Log } Open_{it} + \beta_5 \text{Log } Inf_{it} + \beta_6 \text{Log } Tech_{it} + U_{it} \quad (9)$$

$$\text{Log } LP_{it} = \beta_1 \text{Log } LP_{it-1} + \beta_2 \text{Log } HE_{it} + \beta_3 \text{Log } PHC_{it} + \beta_4 \text{Log } Open_{it} + \beta_5 \text{Log } Inf_{it} + \beta_6 \text{Log } Tech_{it} + U_{it} \quad (10)$$

Where  $i$  and  $t$  represent country and time, respectively. Log (LP) is labour productivity (GDP per person employed), Log (ED) is a proxy for education, Log (HE) is a proxy for health, Log (PHC) is physical capital, Log (Open) is trade openness, Log (Inf) is inflation, and Log (Tech) is the level of advanced technology.

## 4. Estimation Results

### 4.1. The Education Effect: Enrollment in Primary Education

Table 4 shows the correlation between education and GDP per worker by applying a dynamic GMM estimator. The equation is estimated in 3 steps. column (1) shows a simple model which includes labour productivity as the dependent variable, and it is a function of Log enrollment in primary education (ED), Log physical capital (PHC). Results in

column (1) show that the estimated coefficient of Log (ED) is 0.040 and it is associated with a positive and significant (significant at 5%) relationship with labour productivity. This result is compatible with the economic theory that education (measured by the number of students enrolled in primary education) has a positive impact on labour productivity. Also, this result is in line with empirical studies made by Nowak & Kijek [11], Máté, et al [20], Maciulyte-Sniukiene & Matuzeviciute [7], and Dua & Garg [32]. Also, results in column (1) show that the estimated coefficient of Log (PHC) is significant, and it carries the expected sign.

In column (2), Log (Open) and Log (Inf) were added as additional control variables. Thus, Log (LP) became a function of Log (ED), Log (PHC), Log (Open), and Log (Inf). The estimated coefficient of Log (ED) is 0.05 (significant at 5%), confirming the positive association between education and labour productivity. Also, the results in column (2) show that Log (PHC) and Log (Open) have a



significant and positive impact on labour productivity. Also, Log (Inf) has a significant but negative impact on productivity.

In column (3), the variable of internet users (Tech) was added to the equation as a proxy for advanced technology. The results show that the estimated coefficient of Log (ED) is 0.035 and it is positive and significant at (5%). Also, the results confirm the positive and significant association between advanced technology (Tech) and productivity.

In general, the results in Table 4 confirm the robust association between human capital through education and productivity in the selected sample of developing countries over the period (2000-2019). According to results in column (3) a 1% increase in the number of students enrolled in primary education causes labour productivity to rise by

0.035%. Also, physical capital, openness, and the level of advanced technology show a significant and positive correlation with productivity. And inflation shows a significant but negative association with productivity.

The results in table 4. show the p-value of the Sargan test is more than 0.05 Therefore, we accept the null hypothesis which indicates the validity of instruments and the well-specification of the model. The test of (AR2) for serial correlation is more important than the (AR1) because it detects the existence of autocorrelation in the first difference residuals in periods (t-1) and (t-2) [40]. So, we will focus on the results of AR2. The p-value of AR2 in table (4) is more than 0.05 ( $P > 0.05$ ) which indicates that we cannot reject the null hypothesis which indicates that there is no second-order serial correlation in residuals.

**Table 4.** Effect of education on labour productivity: enrollment in primary education.

Explanatory variables	(1)	(2)	(3)
Log (ED)	0.040*** (2.45)	0.05*** (3.54)	0.035*** (2.71)
Log (PHC)	0.047*** (6.87)	0.038*** (4.54)	0.031*** (4.59)
Log (Open)		0.049*** (6.02)	0.047*** (5.12)
Log (Inf)		-0.004*** (2.88)	-0.004*** (2.70)
Log (Tech)			0.009*** (5.05)
Observations	651	583	587
Hansen J-statistic	38.68	40.31	33.65
P-value	0.349	0.285	0.439
Instrumental rank	39	41	39
AR (1)	0.00	0.99	0.00
AR (2)	0.348	0.99	0.32

-\*\*\* denotes that variable is significant at 5%.

- The values in parentheses show the absolute value of the t-statistic.

**Table 5.** Effect of health on labour productivity: life expectancy.

Explanatory variables	(1)	(2)	(3)
Log (HE)	0.088*** (19.06)	0.214*** (4.43)	0.177** (1.79)
Log (PHC)	0.049*** (16.33)	0.040*** (14.97)	0.036*** (5.34)
Log (Open)		0.056*** (9.47)	0.054*** (6.88)
Log (Inf)		-0.004*** (3.58)	-0.005** (1.97)
Log (Tech)			0.007*** (3.51)
Observations	651	583	587
Hansen J-statistic	34.24	20.79	32.42
P-value	0.64	0.979	0.495
Instrumental rank	41	41	39
AR (1)	0.00	0.94	0.000
AR (2)	0.173	0.99	0.473

-\*\*\* denotes that variable is significant at 5%.

-\*\* denotes that variable is significant at 10%.

- The Values in parentheses show the absolute value of the t-statistic.

#### 4.2. The Health Effect: Life Expectancy

Also, results in column (1) in table 5 show that the estimated coefficient of Log (HE) is 0.088 and it is associated with a positive and significant relationship with labour productivity. This result is compatible with economic theory and the empirical studies of Umoru & Yaqub [23], Saif Ullah, et al [8], and Siddique, et al [9]. Also, results indicate that Log (PHC) is significant, and it carries the expected sign. As Log (PHC) correlates positively with labour productivity.

In column 2, Log (Open) and Log (Inf) were added to the

equation as control variables. The estimated coefficient of Log (HE) is 0.214 and it is significant at 5%. Also, Log (PHC) and Log (Open) correlate positively with productivity. And Log (Inf) correlates negatively with productivity.

In column 3, Log (Tech) was added as an additional control variable. The results in column 3 confirm the positive and robust correlation between health and labour productivity. Also, Log (PHC), Log (Open), and Log (Tech) correlate positively and significantly with productivity. While Log (Inf) correlates negatively with productivity.

According to results in column (3), a 1% increase in life

expectancy causes labour productivity to rise by 0.177%.

Also, the results of the Sargan test indicate the well-specification of the model. And the Arellano-Bond test indicates that there is no second-order serial correlation in residuals.

In general, results in tables 4 and 5 confirm the robust association between human capital and labour productivity. This support the economic theory that human capital is the main determinant of labour productivity.

#### 4.3. Standardized Coefficients

To examine which dimension of human capital has the greater impact on productivity in developing countries, it is very important to transform the estimated coefficients into standardized coefficients. So, we estimate a new model including both education and health as independent variables. Table 7 shows the standardized coefficients of education and health based on the estimated coefficients in table 6. According to results in table 7 Log (ED) causes Log (LP) to rise by 0.061. While the association between Log (HE) and Log (LP) is 0.025. These results indicate that education has a greater impact on productivity than health.

**Table 6.** Education and health effects on productivity.

Explanatory variables	(1)
Log (ED)	0.040*** (2.43)
Log (HE)	0.181*** (2.06)
Log (PHC)	0.032*** (3.55)
Log (Open)	0.052*** (5.67)
Log (Inf)	-0.005*** (2.05)
Observations	587
Hansen J-statistic	34.50
P-value	0.395
Instrumental rank	39
AR (1)	0.000
AR (2)	0.417

\*\*\* denotes that variable is significant at 5%.

- The values in parentheses show the absolute value the of t-statistic.

**Table 7.** Standardized coefficients: show the effect of each education and health on productivity.

Variables	(1)
Log (ED)	0.061
Log (HE)	0.025

Standardized coefficients are estimated by using the estimated coefficients of Log (ED) and Log (HE) in table 6.

## 5. Conclusion

The study aimed to investigate the impact of human capital, in terms of education and health, on labour productivity by using panel data of 39 developing countries over the period (2000-2019) and applying a dynamic GMM estimator.

This study utilizes two separate regression models. One model focuses on estimating the impact of education on productivity and the other model focuses on assessing the impact of health on productivity. Each model is estimated in

three steps to verify the relationship between human capital and labour productivity.

The results show that human capital is a crucial determinant of labour productivity in developing countries. also, both education and health have a positive and significant impact on labour productivity.

As a 1% increase in education (ED) causes labour productivity to rise by 0.035%. while a 1% increase in life expectancy (HE) causes labour productivity to rise by 0.177%. These results are compatible with economic theory and many empirical studies. Moreover, the results suggest that education has a greater impact on labour productivity than health. The results also show that physical capital (PHC), trade openness (Open), and the level of advanced technology (Tech) have a positive and significant effect on labour productivity. While inflation (Inf) has the opposite effect on productivity.

Due to the strong association between human capital and labour productivity, the study suggests that:

- 1) Many families in developing countries cannot afford the cost of investing in human capital. Thus, measures should be adopted at the national and international levels. At the national level, social protection programs should be linked to the condition of enrolling in education and following health programs. At the international level, the international aid provided by advanced economics and international institutions should be focused intensely on human development and gives priority to supporting education and health programs.
- 2) Enrollment in primary education should be obligatory and benefit from education development strategies in developed countries to apply to the education systems in developing countries.
- 3) Decision-makers should focus on enhancing the quality of education not only by increasing the number of schools but also by hiring enough highly qualified teachers and improving the curriculum.
- 4) Governments in developing countries should adopt appropriate measures to improve workers' health by providing free treatment to needy people, besides activating the comprehensive health insurance system.
- 5) Governments should launch programs to encourage people to invest in human capital. In addition, increasing the allocations of education and health in the state public budget.

## References

- [1] Goel, V., Agrawal, R. & Sharma, V., 2017. Factors affecting labour productivity: an integrative synthesis and productivity modelling. *Global Business and Economics Review*, 19 (3), pp. 299-322.
- [2] Krugman, P., 1994. *The Age of Diminishing Expectations*. s.l.:s.n.
- [3] OECD, 2015. *the future of productivity*, s.l.: OECD.

- [4] Ezoji, A., Assari, A., Mahdavi, M. R. V. & Jahangard, E., 2019. The Impact of Human Capital (Health and Education) on Labor Productivity; a Composite Model Approach- a Case Study of Iran. *Iranian economic review*, 23 (2), pp. 373-397.
- [5] Perepelkin, V. A., Perepelkina, E. v. & Morozova, E. S., 2016. Evolution of the Concept of "Human Capital" in Economic Science. *international journal of Environmental & Science Education*, 11 (15), pp. 7649-7658.
- [6] Cörvers, F., 1996. The impact of human capital on labour productivity in manufacturing sectors of the European Union. *Research Centre for Education and the Labour Market*.
- [7] Šniukiene, A. M. & Matuzeviciute, K., 2018. Impact of human capital development on productivity growth in EU member states. *Business, Management and Education*, 16 (1), pp. 1-12.
- [8] Saif Ullah, Malik, M. N. & Hassan, M. u., 2019. Impact of Health on Labour Productivity: Empirical Evidence from Pakistan. *European Online Journal of Natural and Social Sciences*, 8 (1), pp. 139-147.
- [9] Siddique, H. M. A., Mohey-ud-din, G. & Adiga K. Kiani, 2020. Human Health and Worker Productivity: Evidence from Middle Income Countries. *International Journal of Innovation, Creativity and Change*, 14 (11), pp. 523-544.
- [10] Razzak, W. A. & Timmins, J., 2010. Education and Labour Productivity in New Zealand. *Applied Economics Letters*, 17 (2), pp. 169-173.
- [11] Nowak, A. & Kijek, T., 2016. The effect of human capital on labour productivity of farms in Poland. *Studies in Agricultural Economics*, pp. 16-21.
- [12] Rukumnuaykit, P. & Pholphirul, P., 2016. Human capital linkages to labour productivity: implications from Thai manufacturers. *Journal of Education and Work*, 29 (8), p. 922-955.
- [13] Arvanitis, S. & Loukis, E. N., 2009. Information and communication technologies, human capital, workplace organization and labour productivity: A comparative study based on firm-level data for Greece and Switzerland. *Information Economics and Policy*, Issue 21, p. 43-61.
- [14] Afrooz, A., 2010. Human Capital and Labor Productivity in Food Industries of Iran. *International Journal of Economics and Finance*, 2 (4), pp. 47-51.
- [15] Lottum, J. v. & Zanden, J. L. v., 2014. Labour productivity and human capital in the European maritime sector of the eighteenth century. *Explorations in Economic History*, Volume 53, pp. 83-100.
- [16] Asghar, N., Danish, M. H. & Rehman, H. u., 2017. Human Capital and Labour Productivity A Case Study of District Lahore. *JPUHS*, 30 (1).
- [17] Chansarn, S., 2010. Labor Productivity Growth, Education, Health and Technological Progress: A Cross-Country Analysis. *Economic Analysis & Policy*, 40 (2).
- [18] Olimpia, N., 2012. Labour productivity and human capital in the Eu countries: an empirical analys. *Ann. Univ. Oradea Econ. Sci*, Volume 1, pp. 324-331.
- [19] Abdul Rehman & Mughal, K., 2013. Impact of Technical Education on the Labor Productivity. *International Journal of Economics, Finance and Management*, 2 (7).
- [20] Máté, D., Darabos, E. & Dajnoki, K., 2016. The impact of human capital on labour productivity regarding 'et 2020'targets. *Network Intelligence Studies*, 4 (7), pp. 61-67.
- [21] Bloom, D. E., Canning, D. & Sevilla, J., 2002. *Health, Worker Productivity, and Economic Growth*. s.l., In 13th annual Health Economics Conference.
- [22] Ugwu, E. I. & Suleiman, Y., 2015. *The Impact of Health on Labour Productivity in Nigeria from 1970 to 2012, Applying the Standard Neo-Classical Growth Framework*. s.l., The European Conference on Politics, Economics and Law 2015.
- [23] Umoru, D. & Yaqub, J. O., 2013. Labour Productivity and Health Capital in Nigeria: The Empirical Evidence. *International Journal of Humanities and Social Science*, 3 (4), pp. 199-221.
- [24] Arshad, M. N. M. & Ab Malik, Z., 2015. Quality of human capital and labor productivity: a case of Malaysia. *International Journal of Economics, Management and Accounting*, 23 (1), pp. 37-55.
- [25] LE, N. H., DUY, L. V. Q. & NGOC, B. H., 2019. Effects of Foreign Direct Investment and Human Capital on Labour Productivity: Evidence from Vietnam. *Journal of Asian Finance, Economics and Business*, 6 (3), pp. 123-130.
- [26] Hassan, A. M., N, N. M. & M, N. Z., 2016. The Impact of Health Care Expenditure and Infectious Diseases on Labour Productivity Performance in Africa: Do Institutions Matter? *Pertanika Journal of Social Sciences & Humanities*, 24 (1), pp. 277-296.
- [27] Keesookpun, C. & Mitomo, H., 2013. A Developmental Framework for ICT and Labour Productivity in Developing Countries: A Case Study of Thailand. *Journal of Information and Communication Research*, 31 (2), pp. 107-121.
- [28] Jajri, I. & Ismail, R., 2010. Impact of labour quality on labour productivity and economic growth. *African Journal of Business Management*, 4 (4), pp. 486-495.
- [29] Yousef, E. M. M. A., 2020. The Determinants of Labor Productivity in Jordan During the Period 1980-2017. *International Journal of Business and Economics Research*, 9 (1), pp. 21-28.
- [30] Deme, M. & Mahmoud, A. M. A., 2020. Effect of quantity and quality of education on per capita real-GDP growth: evidence from low- and middle-income African countries. *Applied Economics*, 52 (57), pp. 6248-6264.
- [31] Trpeski, P., Cvetanoska, M. & Kozheski, K., 2019. *Physical Capital Investments and Labour Productivity Across Countries-Panel Approach*. Zagreb, 49 International Scientific Conference on Economic and Social Development.
- [32] Dua, P. & Garg, N. K., 2019. Determinants of labour productivity: Comparison between developing and developed countries of Asia-Pacific. *Pacific Economic Review*, 24 (5), pp. 686-704.
- [33] Wijaya, A., 2019. The Impact of Trade Openness on Labour Productivity: Evidence from Indonesia. *National Graduate Institute for Policy Studies*.
- [34] Rath, B. N. & Ridhwan, M. M., 2020. The Nexus Among Employment, Productivity and Trade openness: Evidence from Brics and Indonesia. *Bulletin of Monetary Economics and Banking*, 23 (4), pp. 463 - 484.

- [35] Kumar, Saten, Webber, D. J. & Perry, G., 2012. Real Wages, Inflation and labour Productivity in Australia. *Applied economics*, 44 (23), pp. 2945-2954.
- [36] Yildirim, Z., 2015. Relationships among labour productivity, real wages and inflation in Turkey. *Economic Research-Ekonomska Istraživanja*, 18 (1), pp. 85-103.
- [37] Mačiulytė-Šniukienė, A. & Gaile-Sarkane, E., 2014. Impact of information and telecommunication technologies development on labour productivity. *Procedia - Social and Behavioral Sciences*, Issue 110, pp. 1271-1282.
- [38] Kurt, S. & Kurt, Ü., 2015. Innovation and Labour Productivity in BRICS Countries: Panel Causality and Co-integration. *Procedia - Social and Behavioral Sciences*, Volume 195, p. 1295 – 1302.
- [39] Blundell, R. & Bond, S., 2000. GMM Estimation with persistent panel data: an application to production functions. *Econometric reviews*, 19 (3), pp. 321-340.
- [40] Karim, S., 2021. An investigation into the remuneration–CSR nexus and if it can be affected by board gender diversity. *The International Journal of Business in Society*.