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Research Article

Effects of Human Capital and Trade Orientation on Output and Total Factor Productivity in Pakistan

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Abstract: The objectives of this paper were to study effects of human capital and international trade orientation on the output and total factor productivity in Pakistan. The output and Total factor productivity have been estimated using Cobb-Douglas Production function linking per worker output, per worker capital as well as labor force including and excluding the human capital stock for the period of more than five decades from 1961 to 2013. The data was taken from various secondary sources including Pakistan Bureau of Statistics, State Bank of Pakistan and from various issues of Economic Surveys published by Ministry of Finance and was analyzed using SPSS. The role of potential determinants of output as well as total factor productivity such as human capital, exports, imports, FDI, Government consumption expenditure, education expenditure, capital labor ratio, GDP per capita, life expectancy and population have also been analyzed. According to the results the prevalence of decreasing return to scale was observed in all specification of the estimated production functions. Results also exhibit that the physical capital and employed labor force as significant determinants of output. Human capital becomes significant determinant of output when it is interacted with physical capital and employed labor force. An increasing trend in the output and productivity over time has been observed except during the 1970s. Human capital alone as well as its interaction with physical capital has been emerged as significant determinants of total factor productivity. The capital-labor ratio has also been found as significant determinant of productivity. The findings of the study advocate for more investment in both physical as well as human capital in order to increase the output and productivity in the long run.

Keywords: Human capital, output, Pakistan, total factor productivity, trade

INTRODUCTION

In spite of lacking in basic infrastructure at the time of independence in 1947 from British Rule and being a deprived country throughout initial stages of its history, Pakistan's economy has registered a growth rate of 5.26% between 1950 and 1990 (PBS, 2013). However, the rate of economic growth has slowed down during 1990's and stood at 4.44% between 1991 and 2000 (PBS, 2013) but a remarkable recovery was witnessed during early 2000's and Gross Domestic Product (GDP) recorded an average growth rate of 7% between financial years 2003-04 and 2006-07 (Ali *et al*., 2013a; Ministery of Finance, 2013; PBS, 2013). However, global financial crises, worsening law and order situation, energy crises and declining domestic and foreign investment had hampered the economic progress of Pakistan and its economy could only manage to grow at meager rate of 3.26% between 2008 and 2013 (Ministry of Finance, 2013; PBS, 2013).

A sustained and rapid economic growth is considered an essential requirement for the reduction of poverty and promotion of human well-being (McGillivray and Noorbakhsh, 2004) and in turn economic growth of a country depends on both internal and external factors. The Foreign Direct Investment (FDI), exchange rate and international trade are the examples of the external factors while the internal factors includes physical stock of capital, labor force and human capital. The interaction between external factors and other economic as well as non-economic variables affect the real per capita income[1] in a country (Miller and Upadhyay, 1997).

The accumulation of factors and Total Factor Productivity (TFP) has been identified as principle determinant of economic growth in literature on macroeconomics (Miller and Upadhyay, 2002). These factors provide a broader area of research in macroeconomics. However, like other developing countries, Pakistan also lack in accumulation of factor inputs particularly in the stock of physical capital. Resultantly, incremental capital-output ratio is low in Pakistan as equated to other less developed countries. The reason for this low capital-output ratio is lower investment which in turn necessitates the study of TFP (Khan, 2006).

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Further, economy of Pakistan and its economic statistical system have gone through structural changes during the recent past. The base year for the compilation of national accounts of Pakistan has been changed from 1999-2000 to 2005-06 (PBS, 2013). Accordingly, the GDP, which is used as a dependent variable in the growth regressions and TFP calculations, is now being compiled and valued at the concept of basic prices instead of factor cost previously used for valuation purpose. These changes necessitate the need of a fresh study based on fresh data incorporating all the alterations. In this study an attempt has been made to segregate the impact of factors that have a more direct impact on growth of output from those that may have an indirect influence on output. In other words, the factors which determine the total factor productivity are also analyzed separately. A series of models is estimated for a larger and most recent data set for a period of more than 50 years from 1961 to 2013 in Pakistan.

LITERATURE REVIEW AND DEVELOPMENT OF RESEARCH HYPOTHESES

Human capital and output: Research in human capital has entered into a more forward looking approach instead of focusing on current perspective (Chow, 2011). A key role is assigned to human capital in the models based on endogenous growth theory (Afzal *et al*., 2011) and macroeconomic performance is better predicted by the models if human capital is included as an input (Polachek *et al*., 2013). The relationship between human capital and economic growth at macro level has been found as direct and positive in number of studies e.g., (Abbas and Foreman-Peck, 2007; Afzal *et al*., 2011; Awan *et al*., 2011; Bassanini and Scarpetta, 2001; Blundell *et al*., 1999; Doppelhofer *et al*., 2000; Qadri and Waheed, 2011; Son, 2010; Yamauchi, 2010). Human capital is used like an input in the production process and is considered a basic perquisite for promotion of innovation and adaptation and discovery of new technologies (Abbas and Foreman-Peck, 2007; Bassanini and Scarpetta, 2001; Blundell *et al*., 1999; Guichard and Larre, 2006; Miller and Upadhyay, 2002). Further, efficiency of a person's time spent on different activities is increased by human capital (Rosen, 1983) and a long run interaction between human and physical capital further encourages and promote investment in human as well as physical capital (Yamauchi, 2010). The role of human capital in the determination of output at macro level was also analyzed in the current study too and this can be stated in terms of a hypothesis as follows.

Hypothesis 1: Higher the level of human capital, higher the output.

Human capital and productivity: The human capital model is based on the view that increase in the formal years of schooling enhances the productivity of individuals (Aina and Pastore, 2012). These models have social as well as economic implications at micro level in the sense that they help explain and understand the dynamics of labor market, distributions of earning, decisions of schooling, teenage pregnancy and criminal behavior at micro level (Polachek *et al*., 2013). A number of researchers have found positive relationship between human capitals acquired through formal years of schooling and enhanced earnings which are assumed as result of improved productivity (Ali, 2007; Ali and Akhtar, 2014; Ali *et al*., 2013b; Blöndal *et al*., 2002; Branson *et al*., 2013; Fafchamps and Quisumbing, 1998; Faridi *et al*., 2010; Qureshi, 2012; Son, 2010). Some researchers have also tried to explore the relationship between human capital and TFP at macro level. For example, Miller and Upadhyay (1997) found that human capital affect TFP after degree of openness permits some minimum brink level and before that level, a rise in human capital actually cause a decline in TFP instead of increasing it. Same authors in their cross country panel study comprising of 83 countries found that human capital plays much smaller role in the enhancement of growth through TFP (Miller and Upadhyay, 2002). One of the purposes of current study was to explore the relationship between human capital and TFP and as such this can be hypothesized as under.

Hypothesis 2: Higher the level of human capital, higher the productivity.

International trade and output: A dramatic change has occurred in research on international trade during past 15 years (Bernard *et al*., 2012). According to Miller and Upadhyay (1997), international trade rflects greater openness in an economy which in turn helps adoption of efficient production techniques. Due to increase in international trade, the constraints in the foreign exchange are relaxed by the expansion of exports and key inputs can be imported in greater quantity to be used in the process of production. The output in the economy is also increased exogenously due to improvement in terms of trade. Further, a higher orientation of international trade cause increase in the efficiency of resource use by encouraging specialization in some industries in a country (Abizadeh and Pandey, 2009; Miller and Upadhyay, 2002). Therefore, faster economic growth is experienced in countries pursuing policies for the promotion of international trade (Abizadeh and Pandey, 2009; Khan, 2006; Miller and Upadhyay, 2002). Doppelhofer *et al*. (2000) also found partial correlation between various measures of openness like primary exports or real exchange distortions with long term growth in various countries. In the context of current study, the relationship between

international trade and output at macro level was assumed as direct and positive and formally hypothesized as under.

Hypothesis 3: Higher the level of trade, higher the output.

International trade and productivity: The relationship between international trade and productivity has been investigated by number of researchers. For example, Khan (2006) used sum of imports and exports as ratio of GDP as a measure of openness and used this measure as an explanatory variable in the TFP regressions in Pakistan. Some studies have also found positive relationship between trade openness and productivity (Abizadeh and Pandey, 2009; Bustos, 2011; Damijan *et al*., 2004; Khan, 2006; Miller and Upadhyay, 1997, 2002). The current study assumed a positive relationship between degree of openness i.e., international trade and TFP, which is presented in the form of a hypothesis as under.

Hypothesis 4: Higher the level of international trade, higher the total factor productivity.

METHODOLOGY

Following Miller and Upadhyay (1997, 2002) and Khan (2006), the current study also attempted to estimate an extended production functions at macro level and performed multivariate regression analysis taking TFP as a dependent variable. Further, the association between dependent and independent variables has been presented in the form of Fig. 1 as has been done in number of other studies (Ali and Akhtar, 2014; Ali *et al*., 2013a; Ali *et al*., 2013b; Khan, 2007).

The production functions are written as under:

$$Y = A\,F(K, L, H) \tag{1}$$

where, Y denotes to output, A stands for the technology factor, K is capital, L is labor and H is the stock of human capital. Following Miller and Upadhyay (1997, 2002), two functional forms of Cobb-Douglas production function, excluding and including the human capital stock have been used which can be written as under:

$$Y = AK^{\alpha}L^{\beta}\ 0<\alpha<1 \text{ and } 0<\beta<1 \tag{2}$$

$$Y = AK^{\alpha}H^{\gamma}L^{\beta}\ 0<\alpha<1,\ 0<\gamma<1 \text{ and } 0<\beta<1 \tag{3}$$

where, Y stands for real GDP, K is the stock of physical capital, L stands for the number of workers, H is human capital stock and A is an index of TFP. According to Miller and Upadhyay (1997, 2002), variable returns to scale are possible if $(\alpha+\beta)$ or $(\alpha+\beta+\gamma)$ are not restricted to equal to one.

If Eq. (2) and (3) are divided by L i.e., labor force, then output as well as stocks of physical and human capital can be expressed on the basis of per worker as under:

$$y = Ak^{\alpha}L^{\alpha+\beta-1} \tag{4}$$

$$y = Ak^{\alpha}\mathrm{h}^{\gamma}L^{\alpha+\beta+\gamma-1} \tag{5}$$

where, y, k and h are per worker measures of real GDP, stock of physical and human capital respectively. The production functions in (4) and (5) result in constant, increasing or declining returns to scale as $(\alpha+\beta)$ or $(\alpha+$

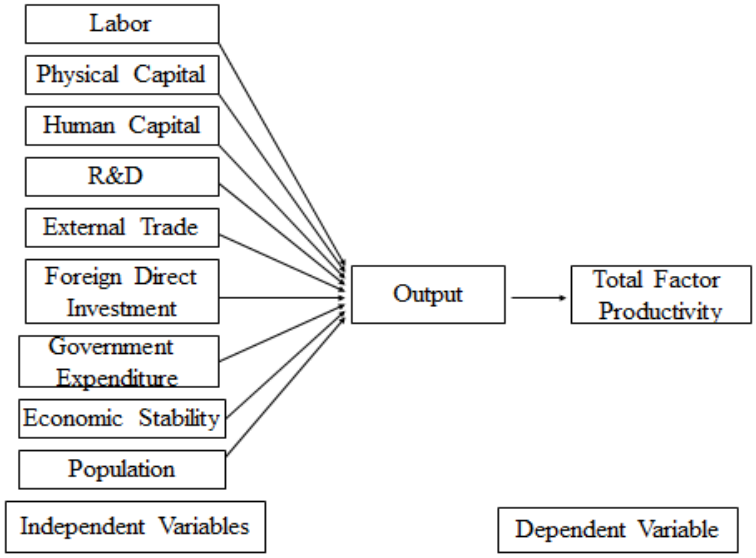

Fig. 1: Estimation approach

β+γ) are equal to, larger than, or fewer than one, correspondingly (Miller and Upadhyay, 1997).

The Eq. (4) and (5) can be re-written in natural logarithms forms as under:

$$lny = lnA + \alpha lnk + (\alpha + \beta - 1)lnL \quad (6)$$

$$lny = lnA + \alpha lnk + \gamma lnh + (\alpha + \beta + \gamma - 1)lnL \quad (7)$$

In Eq. (6) and (7) the statement of constant returns to scale was tested by setting the coefficient of *lnL* equal to zero. According to Miller and Upadhyay (1997), the estimation of equations likes (6) and (7) without the consideration of time specific effect can result in misleading regression in ordinary least square. If time related variables are associated with right hand side variable in the regression, then problems can emerge (Miller and Upadhyay, 1997). Following Miller and Upadhyay (1997), in the present study, time-specific dummy variables have been used i.e., five dummy variables for the five time periods have been used and data has been adjusted by taking deviations from the means over time:

$$lny = lnA + \alpha lnk + (\alpha + \beta - 1)lnL + \sum_{i=1}^{n} \varphi_i x_i + \sum_{i=1}^{5} \omega_i Time_i + \delta D + \epsilon_t \quad (8)$$

$$lny = lnA + \alpha lnk + \gamma lnh + (\alpha + \beta + \gamma - 1) lnL + \sum_{i=1}^{n} \varphi_i x_i + \sum_{i=1}^{5} \omega_i Time_i + \delta D + \epsilon_t \quad (9)$$

where, x_i is the vector of variables including Export to GDP ratio (EX/GDP), Import to GDP ratio (IM/GDP), FDI as percentage of GDP (FDI/GDP), Government final consumption expenditure as percentage of GDP (Gov/GDP), Expenditure on Education as a percentage of GDP (Edu Exp/GDP), ratio of total capital stock to total employment (K/L), rate of inflation, exchange rate, life expectancy at birth (Life) and Population (POP). $Time_i$ (i = 1, 2, ….5) denotes time dummy variables. D is a dummy variable signifying a period of democratic government or military regime. ϵ_t is the error term which assumes to have a zero mean and constant variance.

DESCRIPTION OF VARIABLES, SOURCES OF DATA AND PROPERTIES OF THE SAMPLE

A summary of definitions of the variables used in the study is presented in the Table 1.

Sources of data: Data for the variables reported in the theoretical framework and Table 1 for the period 1960 to 2013 was taken from various sources including Economic Survey of Pakistan, published by Ministry of Finance (various issues), Handbook of Statistics on Pakistan Economy (SBP, 2010) compiled by State Bank of Pakistan, 50 years of Pakistan in Statistics (PBS, 2013), published by then Federal Bureau of Statistics now Pakistan Bureau of Statistics and National Accounts Main Aggregates-2013 released by Pakistan Bureau of Statistics.

Properties of the sample: Average growth rates of important variables such as GDP, per capita income, labor force, physical capital, human capital, population and inflation of the study are reported in the Table 2. In the Table 2, period is mentioned in the column (1) whereas 5 years average growth rates of GDP, per capita income, labor force, physical as well as human capital, population and inflation are reported in the columns (2) through (8). The highest growth rate in GDP i.e., 6.97% in Pakistan was observed during 1961-1965 followed by 6.41 and 6.35%, during 1966-1970 and 1981-1985, respectively (Table 2). The lowest economic growth rate i.e., 3.21% was observed during 1996-2000. According to Ministry of Finance (2013), economy of Pakistan has faced numerous external and

Table 1: Description and definitions of variables

Name of variable	Description
y	Per worker GDP measured in constant market prices (appendix for detail)
k	Per worker stock of physical capital (appendix for detail)
L	Employed labor force
H	A measure of human capital stock (appendix for detail)
h	Per worker stock of human capital
Ex/GDP	Export/GDP*100: a measure of external trade
Im/GDP	Import/GDP*100: a measure of external trade
FDI/GDP	Foreign direct investment/GDP*100
GOV/GDP	Government consumption/GDP*100
Edu Exp/GDP	Education expenditure/GDP*100
Inf_r	Rate of CPI based inflation: a measure of economic stability
Exh_R	Exchange rate of pak rupee against US$: a measure of economic stability
K/L	Ratio of total investment/total employment
y_PC	Constant GDP per capita in rupees
Life	Life expectancy in years
POP	Total population
Time 1	A dummy variable equal to ‘1’ for the time period 1961 to 1970 and ‘0’ other wise
Time 2	A dummy variable equal to ‘1’ for the time period 1971 to 1980 and ‘0’ other wise
Time 3	A dummy variable equal to ‘1’ for the time period 1981 to 1990 and ‘0’ other wise
Time 4	A dummy variable equal to ‘1’ for the time period 1991 to 2000 and ‘0’ other wise
Time 5	A dummy variable equal to ‘1’ for the time period 2001 to 2013 and ‘0’ other wise
D	A dummy variable equal to ‘1’ if a period of democratic government, ‘0’ for a period of a dictatorship or military rule

Table 2: Average growth rates of important variables

	Avg. growth rates of						
Period	GDP	Per capita income	Labor force	Physical capital	Human capital	Population	Inflation
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1961-1965	6.97	4.07	2.89	9.01	5.60	2.85	2.38
1966-1970	6.41	3.65	1.50	8.28	5.25	3.39	4.08
1971-1975	4.95	1.98	2.68	6.66	6.27	3.03	15.36
1976-1980	5.86	4.49	3.47	7.43	5.78	2.81	9.74
1981-1985	6.35	3.22	2.20	7.81	6.44	2.75	8.24
1986-1990	5.63	1.94	2.57	6.99	6.12	2.70	6.14
1991-1995	4.52	1.70	1.08	5.80	5.22	2.60	11.48
1996-2000	3.21	0.49	2.86	4.40	6.15	2.27	7.94
2001-2005	4.87	2.22	2.94	6.00	7.66	1.94	4.97
2006-2010	3.36	2.45	4.47	4.43	5.27	2.71	10.96
2011-2013	4.19	2.24	1.72	5.22	5.27	2.02	10.83
1961- 2013	5.12	2.57	2.61	6.55	5.94	2.66	8.28

Author's calculations based on data of PBS (2013); Avg.: Average

internal shocks from 2007 onwards and economic performance was adversely affected by devastating floods, worsening energy crises and internal security hazards. Power outages alone have shaved off 2% growth in GDP (Ministery of Finance, 2013). However, economy in Pakistan has managed to grow at reasonable growth rate of 5.12% between 1961 and 2013 (Table 2). The highest increase in per capita income i.e., 4.49% was registered during 1976-1980 against the 1996-2000 when it was recorded as lowest i.e., 0.49%. The per capita income has been growing at an average growth rate of 2.57% during 1961-2013 (Table 2). Most of the increase in per capita GDP growth in Asian economies including Pakistan, Iran, Bangladesh, Nepal, the Philippines and Cambodia is attributable to either improvement in labor productivity or contribution of employment rate relative to labor productivity (APO, 2013).

The average growth rate of labor force between 1961 and 2013 has been recorded as 2.61%. The periods of higher growth of physical capital were also the period of higher growth of GDP in Pakistan. For example, 1961-1965 was the period when both GDP (6.97%) and physical capital (9.01%) were highest followed by 1966-1970 and 1981-1985. The period of lowest growth in physical capital (4.40%) i.e., 1996-2000 was also the period of lowest growth of GDP (Table 2). The human capital has been growing at above 5% during all the periods and average growth rate during 1961-2013 stands at 5.94% whereas population growth rate in the same period was recorded as 2.66% (Table 2).

Inflation rate, which is measured by Consumer Price Index in Pakistan, indicates trend of prices of both goods and services in an economy (Ministery of Finance, 2013) and has emerged as the most fluctuating among all the variables. The highest rate of inflation i.e., 15.36% was observed during 1971-1975 followed by 11.5, 11.0 and 10.8% during 1991-95, 2006-2010 and 2011-2013 respectively (Table 2). According to Ministery of Finance (2013), a double digit rate of inflation i.e., above 10% was recorded from January, 2008 to May, 2009 and reached as high as 25% during August 2008 resulting in the inflation rate of 17% during financial year 2008-09. The overall rate of inflation during 1961-2013 has been observed as 8.28% (Table 2).

Five year averages of export to GDP ratio, import to GDP ratio, FDI as percentage of GDP, government expenditure as percentage of GDP, expenditure on education as percentage of GDP, exchange rate of Pak Rupees against US $, life expectancy at birth and years of schooling are given in the Table 3. The average export to GDP ratio during 1961-2013 has been recorded as 10.45 whereas the highest ratio of exports to GDP was observed during 2006-2010 (13.30) followed by 12.97 and 12.53 during 2001-2005 and 1991-1995 respectively. The highest import to GDP ratio i.e., 33.61 was recorded during 1961-1965 followed by 26.77 and 26.38 during 1976-1980 and 1966-1970 correspondingly. The overall average ratio of import to GDP during 1961-2013 was 22.65.

According to Ministery of Finance (2013), FDI has been emerged as a major source of private external inflows of foreign exchange and investment in a developing country like Pakistan and is also considered a source of triggering the technology spillovers, human capital formation and integration of international trade and creation of competitive business environment. Like inflation, FDI has also witnessed wider fluctuations during 1961-2013 averaging at 0.70 in the entire period. The highest FDI in Pakistan i.e., 2.78% of GDP was made during 2006-2010 in contrast to 1971-1975 when it was only 0.07% of GDP whereas its average over the period of 1961-2013 stands at 0.70%. Government expenditure has been averaging at around 11% of GDP during most of the times of the reference period whereas expenditure on education expressed as percentage of GDP has been incurring at the rate of around 2% of GDP. The average exchange rate of Pak Rupee against US $ increased from Rs. 4.76/US$ during 1961-1965 to Rs. 90.30/US$ during 2011-13 showing a depreciation of 1797% in space of 52 years (Table 3). The life expectancy at birth which was 50.51

Table 3: Five year average of important variables

Period	Avg. of: Exports as % of GDP	Imports as % of GDP	FDI as % of GDP	Government expenditure as % of GDP	Education expenditure as % of GDP	Exchange rate (Pak Rs./1US$)	Life expectancy at birth	Years of schooling
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1961-1965	8.37	33.61	0.18	10.08	1.74	4.76	50.51	1.28
1966-1970	9.87	26.38	0.43	11.47	1.76	4.76	50.59	1.49
1971-1975	10.28	21.68	0.07	10.15	1.71	8.65	52.96	1.75
1976-1980	7.57	26.77	0.14	11.82	1.86	9.90	56.68	2.03
1981-1985	8.44	25.19	0.26	11.28	1.54	12.97	59.84	2.36
1986-1990	9.81	21.59	0.47	13.62	2.34	18.86	60.63	2.74
1991-1995	12.53	20.45	0.89	11.96	2.22	27.12	60.70	3.17
1996-2000	10.25	19.10	0.83	10.27	2.30	42.86	63.84	3.66
2001-2005	12.97	16.83	1.07	8.55	1.88	59.06	63.59	4.48
2006-2010	13.30	19.16	2.78	10.13	2.22	69.07	63.90	5.28
2011-2013	12.22	15.52	0.46	10.34	1.90	90.30	65.70	5.80
1961- 2013	10.45	22.65	0.70	10.90	1.95	29.45	58.74	2.99

Author's calculations based on data of PBS (2013), Barro and Lee (2013) and SBP (2010); Avg.: Average

years during 1961-1965 increased to 65.70 years during 2011-13 registering an increase of 30% in 52 years. Similarly, average years of schooling for the population aged 15 and above increased from 1.28 during 1961-1965 to 5.80 during 2011-2013 depicting an increase of 353% in 52 years from 1961 to 2013 (Table 3).

RESULTS

Findings of the study are presented under two headings i.e., analysis of determinants of output and analysis of determinants of TFP in the same order as follows.

Analysis of determinants of output: The estimates of Eq. (8) and (9) and their other modifications are presented in the Table 4. In the Table 4, variables are presented in the column (1) whereas various forms of estimated production functions are given in the columns (2) through (9). The estimates of Eq. (8) are given in columns (2) but only for principal factors of production like labor & capital and time dummies. The coefficient of lnL stands at -0.237 and is significant at 1% level. Its negative sign shows the prevalence of decreasing return to scale in the production function. The coefficient of ln k has a positive value of 0.795 and is also significant at 1% level. It shows the high elasticity of output with respect to stock of physical capital. The coefficients of ln L and ln k syndicate to produce the indirect elasticity of output with respect to labor force of 0.442. Among the time dummies only time 2, which covers the time period of 1970s, is significant at 1% level and its negative sign exhibits lower output as compared to other periods. In the context of Pakistan, the first half of 1970s is characterized by major shift in economic policies from free market economy to nationalization, lower GDP growth rate (4.95%), highest inflation rate (15.36%) and lowest foreign direct investment (0.07% of GDP). During the same period country also engaged in a war with neighboring India and had to witness resultant separation of then East Pakistan (now Bangladesh). The dummy variable 'D' is also significant at 5% level albeit having a low value of its coefficient which is almost zero.

The estimates of Eq. (9) with capital, labor, human capital and time dummies as explanatory variables are given in columns (3) of Table 4. The important characteristic of this equation is the inclusion of per worker measure of human capital in logarithmic form in the estimation of production function. The elasticity of output with respect to stock of physical capital is almost same at 0.80 as was in the specification without human capital. The production function still depicts the decreasing return to scale because the coefficient of ln L is less than one. The output elasticity with respect to per worker stock of human capital has been emerged as insignificant and stands at -0.019. The joint elasticity of output regarding per worker stocks of human and physical capital stands at 0.785 whereas indirect elasticity of output regarding labor stay at same level as was in the specification without human capital i.e., 0.44.

According to Miller and Upadhyay (1997), human capital can also be incorporated in the production by allowing its interaction with both physical capital and labor force. The estimates of production function when human capital is interacted with physical capital and labor force are given in the columns (4) and (5) of Table 4 respectively. The elasticity of output of stock of physical capital is meaningfully affected when interaction term of physical and human capital is included among the explanatory variables and has increased to 0.85 and is significant at 1% level. The interaction term between physical and human capital i.e., lnHlnk having coefficient of 0.027 is also significant at 1% level. The output elasticity of physical capital stands at 0.84 when human capital is interacted with labor force being significant at 1% level. The interaction term between human capital and labor force is also highly significant at 1% level while its coefficient has a positive value of 0.034.

Table 4: Estimated production function

Variables (1)	ln (y) (2)	ln (y) (3)	ln (y) (4)	ln (y) (5)	ln (y) (6)	ln (y) (7)	ln (y) (8)	ln (y) (9)
ln_k	0.795*	0.804*	0.851*	0.840*	0.797*	0.815*	0.861*	0.841*
ln_L	-0.237*	-0.229*	-0.293*	-0.298*	-0.223*	-0.214*	-0.278*	-0.283*
ln_h		-0.019				-0.039		
lnHlnk			0.027*				0.033*	
lnHlnL				0.034*				0.033*
Dln (Ex/GDP)					0.000	0.000	0.005	0.002
Dln (Im/GDP)					0.001	0.002	-0.001	0.003
Dln (FDI/GDP)					0.000	0.000	0.001ǂ	0.001
Dln (GOV/GDP)					0.008	0.008	0.007	0.010ǂ
Dln (Edu.Exp/GDP)					0.009	0.010	0.004	0.004
Inf_r					0.000	0.000	0.000	0.000
ln (Exh_R)					-0.007	-0.002	-0.016*	-0.008ǂ
Dln (K/L)					0.043ǂ	0.047ǂ	0.011	0.011
ln (Life)					0.000	0.001	0.000	0.000
Dln (POP)					0.060	0.056	0.129ǂǂ	0.028
Time 1	0.003	0.002	-0.008ǂ	-0.011#	0.017	-0.005	0.020ǂ	0.008
Time 2	-0.014*	-0.016*	-0.014*	-0.017*	0.002	-0.022#	0.021ǂ	0.003
Time 3	0.000	-0.001	-0.004**	-0.003#	0.016	-0.009	0.033**	0.017
Time 4	-0.001	0.000	-0.021*	-0.011**	0.018	-0.005	0.021ǂ	0.013
Time 5	0.001	0.003	-0.031*	-0.020*	0.020	0.000	0.011	0.004
D	0.005**	0.005**	0.003***	0.001	0.005***	0.004#	0.003#	0.001
N	53	53	53	53	53	53	53	53

Author's calculations; *, **, ***, #, ǂ, ǂ, ǂǂ: Significance at 1, 5, 10, 15, 20, 25 and 30%, respectively; Fixed effects technique has been employed in all regressions; All the variables have been measured by taking deviations from means over time except the time dummies i.e., time 1, time 2, time 3, time 4 and time 5 assuming value '1' for the periods in 1960s, 1970s, 1980s, 1990s and 2000s respectively and '0' otherwise

Column (6) of Table 4 gives the results of estimation of Eq. (8). The elasticity of output regarding stock of per worker physical capital stands at 0.797 and is significant at 1% level. The production function still exhibits the decreasing return to scale. The results of estimation of Eq. (9) are given in the column (7) of Table 4. Addition of human capital in the production function increases the elasticity of output with respect to physical capital to 0.815 although human capital itself is neither significant nor have expected sign. Among the other variables only capital labor ratio has been emerges as significant at 15 and 20% in Eq. (8) and (9), respectively. As such the results of Eq. (9) reported in column (7) of Table 4 does not support the first hypothesis of the study i.e., higher the level of human capital, higher the output. However, when human capital is interacted with physical capital and labor force, it not only becomes highly significant at 1% level but also increases the efficiency of physical capital stock as is evident from the coefficients of ln k in the columns (8) and (9) which stands at 0.861 and 0.841, respectively. Further, coefficients of interactions terms i.e. human capital and physical capital and human capital and labor force are also significant at 1% level. The third hypothesis i.e., higher the level of international trade, higher the level of output is only partially supported because the coefficients of both export and import are insignificant although being positive in all specifications in columns (6) through (9) except for imports in column (8). FDI and government expenditure have emerged as significant determinant of output at 15% level in specifications when human capital is interacted with physical capital and labor force under columns (8) and (9) of Table 4 respectively.

Expenditure on education is although positively correlated with output having positive values of coefficients in all estimated equations in columns (6) to (9) however it is not statistically significant. One of the measures of economic stability i.e., inflation rate has somewhat surprising positive coefficients although they are not significant. However, other measure of stability i.e., exchange rate has been emerged as significant at 1 and 25% levels in specifications when human capital is interacted with physical capital and labor force under columns (8) and (9) of Table 4 correspondingly. This is consistent with findings of Doppelhofer *et al*. (2000).

According to Doppelhofer *et al*. (2000), life expectancy captures a number of factors including health care nutrition, literacy rates and social security. In the current study, life expectancy (ln Life) and population (ln pop) have positive but insignificant coefficients in all specifications except for population which is significant at only 30% level in the specification when human capital is interacted with physical capital under column (8).

Analysis of determinants of total factor productivity: The basic practical outline adopted in this study depends on the determinants of economic growth, particularly, the macro elements of labor productivity growth and TFP growth. The models of determinants of total factor productivity including and excluding human capital can be specified as under:

Table 5: Total factor productivity regressions

Variables	lntfp	Lntfp	Lntfp	lntfph	Lntfph	lntfph
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dln (H)	-0.426*	-0.344**	-0.338**	-0.402*	-0.314**	-0.302***
Dln (Ex/GDP)	-0.002	0.001	-0.001	-0.002	0.001	-0.001
Dln (Im/GDP)	0.003	0.002	0.003	0.003	0.002	0.003
Dln (H) Dln (k)		0.011**			0.011*	
Dln (H) Dln (L)			0.008 ##			0.009ǂ
Dln (FDI/GDP)	0.000	0.000	0.000	0.000	0.000	0.000
Dln (GOV/GDP)	0.004	0.002	0.004	0.004	0.001	0.004
Dln (Edu.Exp/GDP)	0.006	0.009##	0.008	0.007	0.010##	0.009
Inf_r	0.000	0.000	0.000	0.000	0.000	0.000
ln (Exh_R)	-0.003	-0.003	-0.004	-0.002	-0.003	-0.003
Dln (K/L)	0.041 ǂ	0.045#	0.042 ǂ	0.043ǂ	0.047#	0.043ǂ
Dln (POP)	0.051	0.153##	0.078	0.037	0.146##	0.068
Time 1	0.024***	0.005	0.015	0.020#	0.000	0.010
Time 2	0.015	0.006	0.010	0.010	0.000	0.004
Time 3	0.031***	0.025#	0.027#	0.025ǂ	0.019##	0.021##
Time 4	0.032#	0.026#	0.029#	0.028ǂ	0.021##	0.025ǂ
Time 5	0.037#	0.024 ##	0.030 ǂ	0.034#	0.021	0.027##
D	0.003 ##	0.002	0.002	0.003##	0.002	0.002
Adjusted R-squared	0.490	0.557	0.495	0.568	0.634	0.577
F-stat	4.128	4.852	3.999	5.276	6.295	5.167
N	52	52	52	52	52	52

Author's calculations; *, **, ***, #, ǂ, ## and ##: Significance at 1, 5, 10, 15, 20, 25 and 30%, respectively; Dependent variable is the natural logarithm of total factor productivity excluding (tfp) and including (tfph) human capital

$$\ln tfp = \sum_{i=1}^{n} \varphi_i x_i + \sum_{i=1}^{5} \omega_i Time_i + \delta D + \epsilon_t \quad (10)$$

$$\ln tfph = \sum_{i=1}^{n} \varphi_i x_i + \sum_{i=1}^{5} \omega_i Time_i + \delta D + \epsilon_t \quad (11)$$

where, *lntfp* and *lntfph* are measures of total factor productivity excluding and including human capital respectively, x_i is the vector of variables including Human capital stock (H), Export to GDP ratio (EX/GDP), Import to GDP ratio (IM/GDP), FDI as percentage of GDP (FDI/GDP), Government final consumption expenditure as percentage of GDP (Gov/GDP), Expenditure on Education as a percentage of GDP (Edu Exp/GDP), rate of inflation, exchange rate, ratio of total capital stock to total employment (K/L), life expectancy at birth (Life) and Population (POP). $Time_i$ (i =1, 2, ….5) denotes time dummy variables. D is a dummy variable signifying a period of democratic government or military regime. ϵ_t is the error term which assumes to have a zero mean and constant variance.

In the current study, two different measures of TFP including and excluding human capital have been derived separately on the bases of production functions estimated in the previous section. The determinants of total factor productivity excluding (*tfp*) and including (*tfph*) human capital have also been analyzed. Various functional forms of Eq. (10) and (11) have been estimated with *lntfp* and *lntfph* as dependent variables and are presented in Table 5. In the Table 5, name of variables are presented in the column (1) whereas various functional forms of Eq. (17) and (18) are reported in columns (2) to (4) and (5) to (7) respectively. According to results, the coefficients of human capital (*lnH*) stands at -0.426, -0.344 and -0.338 when *lntfp* is dependent variable and are significant at 1 and 5% levels, respectively. However, the value of coefficients of human capital (*lnH*) changed to -0.402, -0.314 and -0.302 when *lntfph* was dependent variable and emerged as a significant at 1, 5 and 10%, levels correspondingly. The negative sign of coefficients of human capital variable in the TFP regressions is somewhat unexpected but in conformity with result of some other studies e.g., Miller and Upadhyay (1997).

The role of trade on TFP has been measured through two variable i.e., exports and imports. According to Miller and Upadhyay (2002), a greater degree of openness results in higher economic growth due to improved productivity. If taken together, both exports and imports, the measures of openness, tell cumulative and consistent story. The estimated coefficients of export to GDP ratio (lnEx/GDP) range between -0.002 to 0.001 in all regressions with *lntfp* and *lntfph* as dependent variable as compared to the value of coefficients of import to GDP ratio (lnIm/GDP) which vary between 0.002 and 0.003 in these regressions but are insignificant. Interestingly, the coefficients of import to GDP ratio have been foundas positive in all specifications which seem relevant by considering the volume of capital intensive machinery and information technology related equipment in the import bill of Pakistan. Further, imports are also considered a major vehicle for transfer of appropriate foreign technology and usually have positive effect on TFP. An increase in imports essentially reduces the technological gap between local and foreign production processes, modern equipment and management (Cororaton, 2002). The hypothesis that higher the level of international trade, higher the total factor productivity is partially supported by the results because although most of the trade related coefficients are positive in the productivity regressions but they are

not significant. Khan (2006) also found an insignificant coefficient of measure of openness in TFP regression.

The collaboration of human capital with both physical capital and labor force may also have an impact on TFP and same has also been investigated. Interaction of human capital with physical capital has been added in columns (3) and (6) of Table 5. The coefficient of interaction term stands at 0.011 in specifications with *lntfp* and *lntfph* as dependent variables and is significant at 5 and 1%, level respectively. Further, interaction of human capital with labor force has also been added in columns (4) and (7) of Table 5. The coefficient of interaction term between human capital and labor force stands at 0.008 and 0.009 in specifications with *lntfp* and *lntfph* as dependent variables and have shown a rather weak significance at 25 and 20% levels correspondingly. Thus a more human capital implies a better use of physical capital as well as labor force and has positive effect on productivity. In this way, human capital is linked with the increase in efficiency and productivity not directly but indirectly via improved use of physical capital and labor force. This finding partially support the hypothesis that higher the level of human capital, higher the total factor productivity.

Foreign direct investment, which is often considered as a source of transfer of technology and prerequisite for an accelerated economic growth, has been found as having neither positive nor significant relationship with productivity. This result is not consistent with finding of other studies e.g., Cororaton (2002) and Khan (2006). Contrarily, government expenditure expressed as percentage of GDP (lnGov/GDP) albeit having a positive association with productivity is found to be insignificant determinant of TFP.

According to Khan (2006), government intervention in the market for education and training is not only likely to improve resource allocation but may also faster growth of productivity in the long run because education investment encourages specialization of labor input. The intuition behind the ideas is that more educated and skilled worker found it easy to adjust themselves according to requirements of knowledge-based and dynamic economy. Expenditure on education measured as percentage of GDP (*lnEdu.Exp/GDP*) has been found as positive and significant determinant of productivity for both measures i.e., *lntfp* and *lntfph* when interaction term of physical and human capital is added in the model under columns (3) and (6) of Table 4 at 25% level. Cororaton (2002) and Khan (2006) also included inflation in the TFP regression as a measure of economic stability. However, unlike the findings of Cororaton (2002) and Khan (2006), the rate of inflation, one of the two measures of economic stability, has been found as insignificant determinant of productivity while the other measure of economic stability i.e., foreign exchange rate is found to be negatively associated with productivity. However, the coefficients of foreign exchange rate are not statistically significant.

The capital labor ratio (*lnK/L*) has been emerged as an important and significant determinant of productivity and its coefficients stands at 0.041 (significant at 20% level), 0.045 (significant at 15% level) and 0.042 (significant at 20% level) when *lntfp* was dependent variable under columns (2) to (4) of Table 4. The coefficients of capital labor ratio when *lntfph* was dependent variable are reported under columns (5) to (7) of Table 4 and stands at 0.043 (significant at 20% level), 0.047 (significant at 15% level) and 0.043 (significant at 20% level). According to Khan (2006), population growth may have a negative effect on TFP owing to the accumulation of idle labor. Contrarily, population growth has also been found as significant determinants of productivity i.e., *lntfp* and *lntfph* in certain specification reported under columns (3) and (6) and value of its coefficients stands at 0.153 and 0.146, respectively.

The coefficients of time dummies with *lntfp* as dependent variable are higher as compared to specifications when *lntfph* was dependent variable and are positive and significant for all time periods except for time 2 which is not significant and are minimum indicating lowest level of productivity during 1970s. Further, increasing trend in the value of time-specific dummy variables under the same specification suggest an increasing level of total factor productivity excluding time 2. As noted earlier in the discussions of output, 1970s is characterized by major shift in economic policies from free market economy to nationalization, higher inflation rate, lower foreign direct investment, lower GDP growth rate. The lower growth rate of output also resulted in the lower level of total factor productivity. The dummy variable 'D' although is positive in all specification but it is only significant at 30% level and in only two specifications under columns (2) and (5) showing a weak association between form of a government i.e., a democratic government or military rule and total factor productivity.

CONCLUSION AND POLICY IMPLICATIONS

The objective of this study was to study the effects of human capital and international trade orientation on the output and total factor productivity in Pakistan. The output and total factor productivity were estimated using Cobb-Douglas Production function connecting per worker output, per worker capital and labor force including and excluding the human capital stock for the period of more than 50 years from 1961 to 2013. The role of potential determinants of output as well as total factor productivity such as human capital, exports, imports, FDI, Government consumption expenditure, expenditure on education, capital labor ratio, GDP per

capita, life expectancy and population have also been analyzed. According to the results the prevalence of decreasing return to scale was observed in all specification of the estimated production functions. A high elasticity of output with respect to stock of physical capital i.e., 0.795 was noted. Further, a significant change in the output elasticity of stock of physical capital was noticed when an interaction term comprising of physical and human capital was included among the explanatory variables. The interaction between physical capital and human capital has also been found as a highly significant determinant of output. Moreover, the interaction between human capital and labor force has also been found as highly significant determining factor of output in Pakistan. Thus, human capital positively affects output when it is interacted with physical capital and labor force.

The hypothesis that higher the level of international trade, higher the level of output is only partially supported by findings of the study because the coefficients of both export and import are insignificant although being positive in all estimated specifications of production functions. Further, FDI and government expenditure have also been emerged as significant determinant of output in production function specifications when human capital is interacted with physical capital and labor force respectively.

Another objective of the study was to estimate total factor productivity excluding and including human capital using the information from estimated production functions. An increasing trend in productivity over time has been observed except during the 1970s. The determinants of both measures of total factor productivity i.e., excluding (*tfp*) and including (*tfph*) human capital have also been analyzed. Results suggest human capital as a significant determinant of productivity in all the estimated specifications. Further, interaction terms between human capital and physical capital and between human capital and labor force have also been found as significant determinants of productivity. Therefore, a more human capital implies a better use of physical capital as well as labor force and has positive effect on productivity. In this way, human capital is linked with the increase in efficiency and productivity not directly but indirectly via improved use of physical capital and labor force and thus support the hypothesis that higher the level of human capital, higher the total factor productivity.

The impact of international trade orientation on productivity was measured through exports and imports whose estimated coefficients range between -0.002 to 0.001 and 0.002 to 0.003 in all regressions, respectively. The hypothesis that higher the level of international trade, higher the total factor productivity is partially supported by the results because although most of the trade related coefficients are positive in the productivity regressions but they are not significant. Moreover, the capital-labor ratio has also been found as significant determinant of productivity signifying the need of more capital investment in the country.

The findings of the study advocate for more investment in both physical as well as human capital in order to increase the output and productivity in the long run.

APPENDIX

Construction of variables:

Output (Y): Real GDP, which is defined as the amount of goods and services made in a nation during a year, has been used as a measure of output. Real GDP takes nominal GDP and modifies for price increases. According to SNA (2008), GDP can be measured at different price concepts such as factor cost, basic prices, producer's prices, purchasers or market prices. Different price concepts differ mostly in the treatment of taxes and subsidies. For example net indirect taxes (indirect taxes less subsidies) are included in the market or purchasers prices but not in the factor cost. GDP at factor cost and basic prices differs only by treatment of other taxes on production and other subsidies on production. GDP at factor cost can thus be calculated from GDP at basic prices by deducting other taxes on production, minus subsidies on production (SNA, 2008). If taxes on products (excluding invoiced value added taxes) are added to and subsidies on products are deducted from GDP at basic prices then GDP at producers' prices can be obtained. Finally if value added taxes, separately invoiced transport charges and wholesalers' and retailers' margin are added to the GDP at producers prices then GDP at market prices can be obtained.

Pakistan's National Accounts main aggregates compiled by Pakistan Bureau of Statistics (PBS), are currently available on three different base years i.e.:

- Base year 1980-81 for the period 1960-61 to 1999-2000
- Base year 1999-2000 for the period 1999-2000 to 2005-06
- Base year 2005-06 for the period 2005-06 to 2012-13

PBS has been compiling GDP at factor cost as well as market prices for the base years1980-81 and 1999-2000. However, after the alteration of base of National Accounts from 1999-2000 to 2005-06, PBS is compiling GDP at basic prices and market prices as per recommendation of 2008 SNA released by United Nations, OECD, IMF, Eurostat and World Bank. The current study is based on the figures of GDP at constant market prices in order to complete a time series for a longer period of time due to absence of any other common valuation concept. It is pertinent to mention that prior to 1999-2000 GDP figures were available on the base year 1980-81 for the period 1960-61 to 1999-2000 which were converted into the prices of 2005-06 by splicing method.

Labor (L): The labor input has been measured as employed labor force for the respective periods. The data for the labor force have been taken from 50 years of Pakistan in Statistics published by PBS, Labor Force Surveys (various issues) and Economic Survey of Pakistan published by Ministry of Finance, Government of Pakistan.

Capital stock (K): Capital is considered an important input in the process of production and its measurement is essential because of its inevitable role in the analysis of growth, economic forecasting and technical change. The measurement of capital stock in an economy is difficult due to the fact that owners as well users of capital goods are often same. An indirect estimation of value of capital goods is often required because most of the capital goods can be used for more than a year (Nehro and Dharashwar, 1993).

According to SNA (2008), the estimation of value of capital stock is not a simple procedure and its measurement is possible either by direct surveys or by indirect approach known as Perpetual Inventory Method (PIM). PIM rests on the idea that investment made in the past result in accumulation of stock of capital in the current period. However, measuring capital stock through PIM requires rationale for choosing a particular age-price or age-efficiency profile, estimation of useful life and retirement patterns of assets (SNA,

2008). Unfortunately, information on these aspects of capital goods is not readily available particularly in developing countries like Pakistan.

In empirical research, the first problem in the estimation of capital stock is to determine the initial capital stock. A number of researchers have estimated the value of investment in first period by running a linear regression of log of investment against time e.g., Khan (2006) and Nehro and Dharashwar (1993). Under this method, an entire investment series is used and thus make the results less sensitive to the initial period conditions. In the next stage, initial capital stock is calculated by using the fitted value of initial investment through following equation:

$$K_{t-1} = \frac{I_t}{(g+\emptyset)} \quad (1A)$$

where, $K_{t-1}$is the capital stock in period t-1, I_t is the investment in period t, g is the growth rate of GDP and $\emptyset$ is the constant rate of Consumption of Fixed Capital[2] (CFC). The method of estimation of initial capital described in Eq. (10) has also been used in number of other studies e.g., (Ahmad *et al*., 2008; Khan, 2006; Nehro and Dharashwar, 1993). Stock of productive capital has been estimated using method of Musso (2006):

$$K_t = (1 - \emptyset_t)K_{t-1} + \frac{I_t + I_{t-1}}{2} \quad (2A)$$

where, $\emptyset_t$, is the rate of CFC, I_t is the amount of real investment. Following Ahmad *et al*. (2008), Khan (2006) and Nehro and Dharashwar (1993), a fixed rate of CFC i.e., 4.0% has been used in the derivation of stock of capital. The Gross Fixed Capital Formation (GFCF) compiled by PBS and measured in constant market prices of 2005-06 have been used as real investment for this study. GFCF data prior to 1999-2000 was available on the base year 1980-81 for the period 1960-61 to 1999-2000 which were converted into the prices of 2005-06 by splicing method. The Wharton method[3] as was used by Ahmad *et al*. (2008) has been followed to adjust the capital stock for business fluctuations.

Human capital: The average educational attainment (years of schooling) for the adult population aged 15 years and above, available from the Barro and Lee (2013) data set have been used to calculate the stock of human capital. The human capital stock has been measured at the commencement of each five-year period instead of an average over the period (i.e., 1961 for the 1961-65 time period). Data on average years of primary, secondary and tertiary schooling for age groups 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74 and 75, respectively and above along with total population falling in these age groups is available (Barro and Lee, 2013). The procedure to derive the human capital during a time period 't' can be described as under:

$$YS_{11}.P_1 + YS_{12}.P_1 + YS_{13}.P_1 = (YS_{11} + YS_{12} + YS_{13}).P_1 \quad (3A)$$

$$YS_{21}.P_2 + YS_{22}.P_2 + YS_{23}.P_2 = (YS_{21} + YS_{22} + YS_{13}).P_2 \quad (4A)$$

$$YS_{31}.P_3 + YS_{32}.P_3 + YS_{33}.P_3 = (YS_{31} + YS_{32} + YS_{33}).P_3 \quad (5A)$$

$$YS_{n1}.P_n + YS_{n2}.P_n + YS_{n3}.P_n = (YS_{n1} + YS_{n2} + YS_{n3}).P_n \quad (6A)$$

where, YS is the years of schooling in the respective age categories for individual having completed a specified level of education. E.g., YS_{11} stands for average years of primary schooling completed by the individuals in the age group 15-19 years and P's are the population in the respective age categories.

Writing Eq. (11) through (15) in summation notations, yields a following expression for the derivation of human capital stock in the period 't':

$$H_t = \sum_{i=1}^{n} \sum_{j=1}^{k} YS_{i,j} \times P_i \quad (7A)$$

where,

H_t : The human capital stock for a time period t

YS : The average years of schooling for individuals in the i^{th} age group having j^{th} level of schooling

P_i : The population in the i^{th} age group

The human capital stock has been derived by using Eq. (16) with an interval of 5 years due to data limitations. The missing values have been interpolated by using annual average compound growth rate of human capital of two consecutive time periods.

REFERENCES

Abbas, Q. and J. Foreman-Peck, 2007. Human Capital and Economic Growth: Pakistan, 1960-2003. Cardiff Economics Working Papers, E2007/22, Cardiff Business School, Cardiff University.

Abizadeh, S. and M. Pandey, 2009. Trade openness, structural change and total factor productivity. Int. Econ. J., 23(4): 545-559.

Afzal, M., M.E. Malik, I. Begum, K. Sarwar and H. Fatima, 2011. Relationship among education, poverty and economic growth in Pakistan: An econometric analysis. J. Elem. Educ., 22(1): 23-45.

Ahmad, K., M.A. Chaudhary and M. Ilyas, 2008. Trends in total factor productivity in pakistan agriculture sector. Pak. Econ. Soc. Rev., 46(2): 117-132.

Aina, C. and F. Pastore, 2012. Delayed graduation and over-education: A test of the human capital model versus the screening hypothesis. Discussion Paper No. 6413, IZA, Bonn, Germany.

Ali, L., 2007. Returns to education in Pakistan. M.Phill. Thesis, Department of Economics, International Islamic University (IIU), Islamabad, Pakistan.

Ali, L. and N. Akhtar, 2014. An analysis of the gender earning differentials in Pakistan. Res. J. Appl. Sci. Eng. Technol., 7(13): 2772-2784.

Ali, L., M.I. Ramay and Z. Nas, 2013b. Analysis of the determinants of income and income gap between urban and rural Pakistan. Interdiscipl. J. Contemp. Res. Bus., 5(1): 858-885.

Ali, L., Z. Nas and M.I. Ramay, 2013a. Higher productivity of workers leads to higher profit for the firms: Evidence from large scale manufacturing industries in Pakistan. Int. J. Contemp. Bus. Stud., 4(6).

APO, 2013. APO Productivity Databook 2013. Asian Productivity Organization, Tokyo, Japan.

Awan, N.W., S.M.H. Shah and H. Rasheed, 2011. A dynamic analysis of education and economic growth in Pakistan: Analysis in form of co-integration. Gomal Univ., J. Res., 27(1): 31-53.

Barro, R. and J.W. Lee, 2013. Educational Attainment for Total Population, 1950-2010. Barro-Lee Educ. Attainment Dataset, 1.3(4). Retrieved from: http://www.barrolee.com (Accessed on: Oct 16, 2013).

Bassanini, A. and S. Scarpetta, 2001. Does Human Capital Matter for Growth in OECD Countries? Evidence from Pooled Mean-group Estimates. OECD Economics Department Working Papers No. 282, OECD Publishing, Paris, DOI: 10.1787/424300244276.

Bernard, A.B., J.B. Jensen, S.J. Redding and P.K. Schott, 2012. The empirics of firm heterogeneity and international trade. Ann. Rev. Econ., 4: 283-313.

Blöndal, S., S. Field and N. Girouard, 2002. Investment in Human Capital through Post-compulsory Education and Training: Selected Efficiency and Equity Aspects. OECD Economics Department, Working Papers No. 333, OECD Publishing, Paris, DOI: 10.1787/778845424272.

Blundell, R., L. Dearden, C. Meghir and B. Sianesi, 1999. Human capital investment: The returns from education and training to the individual: The firm and the economy. J. Fiscal Stud., 20(1): 1-23.

Branson, N., C. Ardington, D. Lam and M. Leibbrandt, 2013. Changes in Education, Employment and Earnings in South Africa-a Cohort Analysis. A Southern Africa Labour and Development Research Unit Working Paper No. 105. SALDRU, University of Cape Town, Cape Town.

Bustos, P., 2011. Trade liberalization, exports and technology upgrading: Evidence on the impact of MERCOSUR on argentinian firms. Am. Econ. Rev., 101(February): 304-340.

Chow, W., 2011. Human Capital and Total Factor Productivity. Economic Analysis and Business Facilitation Unit. Retrieved from: www.hkeconomy.gov.hk/en/pdf/human_capital_tfp.pdf (Accessed on: June17, 2011).

Cororaton, C.B., 2002. Total Factor Productivity in the Philippines. Philippine Institute for Development Studies, Discussion Paper Series No. 2002-01 (Revised), Retrieved from: http://www.pids.gov.ph.

Damijan, J.P., S. Polanec and J. Prašnikar, 2004. Self-selection, Export Market Heterogeneity and Productivity Improvements: Firm Level Evidence from Slovenia. LICOS Discussion Paper No. 148, Retrieved from: http://hdl.handle.net/10419/74889.

Doppelhofer, G., R.I. Miller and X. Sala-i-Martin, 2000. Determinants of Long-term Growth: A Bayesian Averaging of Classical Estimates (Bace) Approach. OECD Economics Department Working Papers, No. 266, OECD Publishing, Paris.

Fafchamps, M. and A.R. Quisumbing, 1998. Human capital, productivity and labor allocation in rural pakistan. FCND Discussion Paper No. 48, Food Consumption and Nutrition Division, International Food Policy Research Institute, Washington.

Faridi, M.Z., S. Malik and R.I. Ahmad, 2010. Impact of education and health on employment in Pakistan: A case study. Eur. J. Econ. Financ. Admin. Sci., 18(2010).

Guichard, S. and B. Larre, 2006. Enhancing portugal's human capital. OECD Economics Department Working Papers, No. 505, OECD Publishing. DOI: 10.1787/871641300584.

Khan, S.U., 2006. Macro determinants of total factor productivity in Pakistan. SPB Res. Bull., 2(2): 384-401.

Khan, A., 2007. Performance appraisal's relation with productivity and job satisfaction. J. Manage. Sci., 1(2): 99-114.

McGillivray, M. and F. Noorbakhsh, 2004. Aid, conflict and human development. Proceeding of the Making Peace Work, World Institute for Development Economics Research, United Nations University, Helsinki.

Miller, S.M. and M.P. Upadhyay, 1997. The Effects of Trade Orientation and Human Capital on Total Factor Productivity. Working Paper 1997-07, Working Paper Series, Department of Economics, University of Connecticut.

Miller, S.M. and M.P. Upadhyay, 2002. Total Factor Productivity, Human Capital and Outward Orientation: Differences by Stage of Development and Geographic Regions. Economics Working Paper 200233. Department of Economics, University of Connecticut, Retrieved from: http://digitalcommons.uconnedu/econ_wpapers/200233.

Ministery of Finance, G.O.P., 2013. Economic Survey of Pakistan (ESP), 2012-13. Ministery of Finance, Government of Pakistan, Islamabad. Retrieved from: http//www.finance.gov.pk.

Musso, P., 2006. Capital Obsolescence, Growth Accounting and Total Factor Productivity. Revue de l'OFCE, , 2006/5 (no 97 bis), pp: 217-233. DOI: 210.3917/reof.3073.0217.

Nehro, V. and A. Dharashwar, 1993. A new database on physical capital stock: Sources, methodology and results. Rev. Anal. Econ., 8(1): 37-59.

PBS, 2013. National Accounts, Macro Economic Indicators, Table 1. Pakistan Bureau of Statistics, Statistics Division, Government of Pakistan, Islamabad. Retrieved from: http//www.pbs.gov.pk.

Polachek, S.W., T. Das and R. Thamma-Apiroam, 2013. Heterogeneity in the Production of Human Capital. Discussion Paper No. 7335, IZA, April 2013.

Qadri, F.F.S. and A. Waheed, 2011. Human capital and economic growth: Time series evidence from Pakistan. Pak. Bus. Rev., 1(2011): 815-833.

Qureshi, M.G., 2012. The Gender Differences in School Enrolment and Returns to Education in Pakistan. PIDE Working Papers, Pakistan Institute of Development Economics, Islamabad, 2012: 84.

Rosen, S., 1983. Specialization and human capital. J. Labor Econ., 1(1).

SBP, 2010. Handbook of Statistics on Pakistan Economy. Statistics and DWH Department, State Bank of Pakistan, Karachi. Retrieved from: http//www.sbp.org.pk.

SNA, 2008. System of National Accounts 2008: European Commission. International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank.

Son, H.H., 2010. Human Capital Development. Economics Working Paper Series No. 225, Asian Development Bank (ADB), Manila, Philippines, Retrieved from: www. adb.org/economics.

Yamauchi, F., 2010. Human Capital Formation: History, Expectations and Challenges in South Africa. International Food Policy Research Institute, Washington, D.C., U.S.A.

End notes:

1: Per capita income is defined as gross national income of a country divided by its total population. The per capita income in Pakistan for the year 2012-13 stands at US$1368 (PBS, 2013)

2: According to SNA (2008), CFC is the decline in the value of assets owing to their use in the process of production and is the sum of payment spread over the useful life of assets instead of deductions made from the value of production in an accounting period when an asset is acquired.

3: For detail of this method see Ahmad *et al*. (2008).