Original Article

An analysis of total factor productivity and economic growth in Pakistan

JHSS
50-87

Vol. 30 (2), 2022

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Abstract

The broad aim of this paper is to find-out the contribution of Total Factor Productivity (TFP) to economic growth of Pakistan in the presence of human capital and check its sensitivity to share of capital, proxies for human capital and length of period. The study used Growth Accounting Method for this purpose. The study is of a different nature in sense that it has used three different proxies for human capital and the calculations of TFP have been made by using different shares of labour and capital. The results show that TFP contributed 38.47% to Gross Domestic Product (GDP) per capita in Pakistan during the period 1971-2008, with education as measure of human capital. The contribution of TFP to GDP per Capita increases irrespective of measure of human capital when minimum share of capital is used. It increases to 46.72%, 57.08% and 24.14 % in case of education, health and Research & Development (R&D) respectively. However, in case of maximum share of capital, the TFP becomes 20.99%, 27.80% and 6.3% with education, health and R&D as a measure of human capital. The study suggests TFP to be an important determinant of economic growth in Pakistan, hence, the determinants of TFP needs to be explored to attain sustained economic growth.

Keywords: Total factor productivity, economic growth, sensitivity analysis, growth accounting method

JEL Classification I15, I25, J24, O15, O49

Introduction

The growth performance of Pakistan experienced huge ups and downs since its inception. The growth performance of Pakistan on average remained very good in 1980s. Its economic growth rate on average was 6.42 % during the period 1980-1989 (State Bank of Pakistan, 2005). The average growth rate remained 4.8% and 4.6% during the periods 1990-99 and 2000-2008 (State Bank of Pakistan, 2005; Economic survey of Pakistan, 2008-09). The national

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economy grew at a respectable rate of 5.8 % and 6.8% in years 2005-06 and 2006-07 (Economic Survey of Pakistan, 2007-08). It was a better performance than countries like Korea, Indonesia, Malaysia, Thailand and Bangladesh. In order to achieve a sustained economic growth, the determinants of economic growth need to be explored in Pakistan.

There has been a lively debate on the determinants of economic growth over the last three decades. It is being studied whether factor accumulation or TFP is the determinant of variation in per capita GDP growth. The economic growth empirics are considered incomplete without taking into account the Total Factor Productivity (TFP). A major problem in growth empirics of Solow type models is the value of residual. The study of TFP is mainly the computation of this residual. Therefore, TFP is also known as Solow Residual. The TFP is mainly calculated by using the Growth Accounting Method (GAM), which breaks the economic growth into its associated components. Nehru and Ashok (1994) estimated TFP for a sample of 83 countries and found human capital an important factor for explaining the economic growth. TFP growth in high income economies was found comparable with the low and medium growing economies. Moreover, according to the study, the cross country variation in income is due to political stability and initial conditions of the economies. The actual TFP growth in Sub Saharan Africa remained lower than the TFP predicted on the basis of the political stability and initial conditions.

Pakistan is endowed with rich human resources but unfortunately, instead of properly harnessing these resources, most of human resources are engaged in traditional agriculture sector and resultantly underutilized. There have been very few efforts to find the determinants of economic growth in presence of human capital. Human capital in different forms can be utilized to cover the fluctuations in economic growth rate and get a sustained growth rate. Apart from the traditional determinants of economic growth, the study of TFP can prove an effective tool for this purpose. But, considering only TFP as determinant of economic growth can give misleading results (Nelson and Howard, 1997). The initial level of TFP, physical and human capital is responsible for explaining the cross-country variation in TFP levels (Sinhaji, 1999). The economic growth literature relevant to Total Factor Productivity (TFP) is rich in case of developed countries but we find fewer studies in case of developing countries. The foremost reason is data availability problems in these economies. In case of Pakistan, we find limited studies but most of them concentrated on sector- wise TFP especially on agriculture and manufacturing sectors. Khan (2006) found macroeconomic stability, Foreign Direct Investment (FDI) and financial sector development as major contributors to

TFP in Pakistan in the period 1965-2005. Ahmad (2007) suggested rapid domestic investment, losing the private credit, enhancing trade and more expenditure on education to reap the fruits of economic growth.

The aim of the present study is to find the contribution of TFP in presence of human capital. We are using different measures of human capital for this purpose. An effort has been made in this paper to find the sensitivity of the contribution of TFP to different measures used as proxoies for human capital and the share of capital.

Data and Methodology

The present study is based on secondary data for the period 1971-2008. The has been taken from Economic Survey of Pakistan (Various Issues), State Bank of Pakistan (2005), World Development Indicators (various issues), Human Development Reports. In order to achieve objectives of the study, Growth Accounting Method (GAM) is being employed here. Growth Accounting is the process, which breaks the observed economic growth into elements associated with variation in factor inputs (Barro, 1999). The growth accounting has been widely used in economic growth literature. A number of studies like Solow (1957), Kenderick (1961), Jorgenson and Zvi (1967), Jorgensen and Fraumeni (1992), and Young (1995), used this method for finding the effects of various factors on economic growth. This method is considered best because, it provides estimates of factoral share in economic growth. The problem, which is faced in growth regressions, is the value of the residual which is unknown. This value is referred to as Solow residual or Total Factor Productivity. The calculation of TFP is placed in a central position in the empirical growth studies as it covers all omitted factors. Chen (1997) called it, a measure of our ignorance. The Growth Accounting Method (GAM) helps in calculation of this residual. The Starting point of this method is standard production function as given below

$$Y = F(A, K, L) \quad (1)$$

Where Y shows output, A shows the level of technology or effectiveness of labour, K is capital input and L is labour input

Differentiating (1) with respect to time and dividing by Y, we get

$$\frac{Y'}{Y} = g + \frac{F_k \mathbf{K}}{\mathbf{Y}} \cdot \frac{\mathbf{K}'}{\mathbf{K}} + \frac{\mathbf{F_L}\, \mathbf{L}}{\mathbf{Y}} \cdot \frac{\mathbf{L}'}{\mathbf{L}} \quad (2)$$

Where

The symbol 'g' shows growth due to technological change. $\frac{F_k \mathbf{K}}{\mathbf{Y}}$ and $\frac{\mathbf{F_L\ L}}{\mathbf{Y}}$ are the capital and labour input shares in total output. As the share of capital is its rental price and the share of labour is wages, so we denote their shares in the output by S_k and S_L respectively.

So the form of equation becomes

$$\frac{\dot{Y}}{Y} = g + S_k \frac{K'}{K} + S_L \frac{L'}{L} \quad (3)$$

If $y = \frac{\dot{Y}}{Y}$, $k = \frac{K'}{K}$ and $l = \frac{L'}{L}$ then

$$y = g + S_k k + S_L l \quad (4)$$

Now the share of technological progress can be computed as

$$g = y - S_k k - S_L l \quad (5)$$

The value of $'g'$ is generally known as Total Factor Productivity, which shows contribution of other factors in economic growth than the observed factors. This is also called Solow Residual.

As major objective of the present study is to find out the role of human capital in economic growth of Pakistan, therefore by introducing human capital in TFP Model, the model becomes of the form

$$\boldsymbol{g = y - S_k k - S_L l - (1 - S_k - S_l) h_c} \quad \textbf{(6)}$$

In equation (6), 'y' is the growth rate of the GDP Per Capita, $'k'$ is the growth rate of physical capital (Gross Fixed Capital) and $\boldsymbol{h_c}$ is growth rate of human capital. The human capital has been measured by Education and Health for calculation of TFP.

A different approach to the calculation of Total Factor Productivity is the dual approach elaborated by Barro (1999). In dual approach, TFP is computed by using growth of factor prices instead of growth of factor quantities. This approach computes TFP from the given equation

$$Y = rK + wL \quad (7)$$

Where 'r' is the rental price of capital and 'w' is the wage rate of labour. Taking derivative of equation (7) with respect to time and dividing by Y

$$\frac{Y}{Y} = \frac{1}{Y}[r\,K + r\,K] + \frac{1}{Y}[wL + wL] \quad (8)$$

And after simplification we get

$$S_K\,[r / r] + S_L\,[w / w] = TFP \quad (9)$$

Where, S_K and S_L are the shares of capital and labor in factor incomes.

The computation of Total Factor Productivity becomes easy, if the factor shares in total factor incomes or the rental price of capital and wage rate of labour data is available. This is done mostly in case of developed countries but unfortunately the data relevant to rental price of capital and wages of labour in developing country is mostly unavailable, which creates hurdles in computation of TFP. The same is the case in the present study, where wage data is not available so the factor share is difficult to compute.

In order to tackle the problem of factor shares, different solutions are suggested in empirical studies. One solution for this problem used in literature is the partial elasticities obtained from the regression of Cobb Douglas Production Function. But in this method major problem is of endogeniety as the growth of factor inputs can be correlated to the value of the residual.

The second solution for the problem of non-availability of factor shares as adopted by number of studies is the use of constant share of labour and capital. The constant share of capital used in economic growth literature varies from 0.3 to 0.40. Besudeb and Bari (2000), Baier *et al* (2002), and Iwata *et al* (2002), used constant capital share in the range of 0.30-0.35. Some of the studies used this share in the range of 0.25 to 0.50 in economic growth literature[4]

Therefore, due to non-availability of proper data for factor shares and on the basis of studies relevant to Pakistan and similar economies, the present

[4]Young (1992), Sarel (1997), Nelson and Pack (1999), Ahmad *et al* (2008) and Park (2010) used the fixed capital share from 0.25 to 0.50 for the estimation of Total Factor Productivity in different countries.

study has used constant shares of factors as 0.33 for capital and labour, and 0.34 for human capital[5]. The equation used for TFP estimation is given below

$$g = y - 0.33\,k - 0.33\,l - 0.34\,h_c \quad (10)$$

The Total Factor Productivity has been computed on five and ten yearly basis. This is done to find out the expected effect of time variation on TFP. The study has also used different measures of human capital to find the extent of sensitivity of TFP to these measures. The extreme bounds of TFP in economy of Pakistan have been worked out by exercising the extreme shares of capital, labour and human capital used in literature. Therefore, by taking into account these shares the following models are used for this purpose.

$$g = y - 0.25k - 0.37\,l - 0.34\,h_c \quad (11)$$

$$g = y - 0.50\,k - 0.25\,l - 0.25\,h_c \quad (12)$$

In equation (11) and equation (12), 0.25 and 0.50 are the extreme shares of capital. These equations are expected to give an extreme contribution of the TFP to economic growth of Pakistan. It will provide the range in which TFP can lie in empirical studies relevant to TFP and determinants of economic growth.

Results and Discussion

The present study is based on Growth Accounting Method (GAM) for calculating the TFP in Pakistan Economy during the period 1971-2008. The major obstacle in calculation of TFP was the factor shares. It was a tough task to get appropriate shares of physical capital ($S_{K)}$, labour ($S_{L)}$ and human capital ($1- S_K- S_L$). Following the Studies relevant to Pakistan and other economies of same nature, the constant share of capital has been used as 0.33, the share of labour as 0.33 and share of human capital as 0.34[6].

It may be useful, to give a cursory look to the growth of variables relevant to Total Factor Productivity before proceeding to empirical results. The variables of the study grew at different rates during the study period as shown in Table 1. The Gross Domestic Product Per Capita (GDPPC) grew at

5 Besudeb & Bari (2000), Baier et al (2002), *Ahmad et al* (2008), and Park (2010) used similar shares for South Asia, Vietnam, Indonesia and a set of 145 countries.

6 Besudeb &Bari (2000), Park (2010), Ahmad *et al*(2008),and Baier *et al* (2002) used the capital share within the range of 0.33-0.40 for various developing countries including Pakistan.

4 percent during 1971. It showed handsome increase in next two years but a visible fall in 1975 and 1976. Its growth rate remained in double digit till 1984 but it remained in single digit the following years till 1989. In 1990s, the growth rate of GDPPC remained good but at the end of the decade it fell to 0.05. The growth rate of GDPPC stayed stable in 2000s.The overall growth of GDPPC remained 13 percent during the period 1971-2008.

The growth rate of physical capital (GFCF) showed huge variation in the study period. In 1971, the growth rate of physical capital was 3 percent but in 1974 and 1976, it remained exemplary. The growth rate of physical capital remained stable during 1980s and 1990s with the exception of last few years of 1990s. During the 2000s, it showed much higher fluctuations. As a whole, it grew on average at 17 percent during the study period.

The labour growth rate was 3% at the beginning of the study period. The growth rate of labour remained mostly below 5% annually during 1970s. During 1980s, the growth rate behaved in similar fashion with the exception of two years 1982 and 1989, when it remained 5% and 12% respectively. The growth rate of labour mostly remained below 5% till the end of the study period except the years 1996 and 2005. The overall growth of labour during 1971-2008 remained 3% per annum. Human capital in form of education (ENRG) also elucidated massive variation. The growth rate of ENRG increased from 3% in 1971 to 7% per annum in 1973 and 12% in 1976. The growth rate of ENRG remained substantially low from 1977 to 1980. However, the growth rate increased to 11% in 1984 but the arte was not stable as it fell down in next 4 years. The overall growth of ENRG during 1971-2008 is 4% percent. The growth rate of health (Life Expectancy) remained mostly within the range of 1% to3%. It showed zero growth for many years during the period 1971-2008. The R&D sector in Pakistan experienced dramatic fluctuations. Its growth rate was negative (-15%) in at the beginning of the period but it increased very rapidly in following years of 1970s. The same behaviour of growth rate of R&D continued in 1980s and 1990s. It growth rate seemed exemplary till mid of 2000s but huge shocks can be seen 2006 to 2008. The overall growth rate of R&D remained 18.9% during the study period.

Table I Annual Growth Rate of Variables during 1971-2008

Year	GDP Per Capita	GFCF	School Enrollment	Labour	Health	R&D	Year	GDP Per Capita	GFCF	School Enrollment	Labour	Health	R&D
1971	0.04	0.03	0.03	0.03	0.02	-0.15	1991	0.15	0.20	0.05	0.00	0.00	0.06
1972	0.19	-0.03	0.05	0.04	0.00	0.19	1992	0.08	0.26	0.01	0.03	0.00	0.23
1973	0.29	0.12	0.07	0.00	0.00	0.32	1993	0.14	0.14	0.14	0.03	0.02	0.12
1974	0.23	0.39	0.07	0.04	0.02	0.15	1994	0.16	0.09	0.06	0.03	0.00	0.21
1975	0.12	0.15	0.05	0.01	0.00	0.41	1995	0.18	0.13	0.09	0.04	0.02	0.16
1976	0.10	0.87	0.12	0.04	0.01	0.21	1996	0.13	0.16	0.00	0.07	0.00	0.12
1977	0.14	0.16	0.00	0.04	0.00	0.22	1997	0.10	0.08	0.05	0.02	0.00	0.07
1978	0.08	0.10	-0.08	0.02	0.00	0.26	1998	0.05	0.02	0.10	0.02	0.01	-0.71
1979	0.15	0.09	0.01	0.03	0.00	0.31	1999	0.06	0.01	0.05	0.05	0.01	0.13
1980	0.14	0.25	0.02	0.03	0.03	0.08	2000	0.30	0.48	0.04	0.02	0.00	0.23
1981	0.14	0.21	0.04	0.03	0.00	0.33	2001	-0.16	0.09	-0.10	0.01	-0.02	0.00
1982	0.10	0.14	0.05	0.05	0.00	-0.17	2002	0.08	0.03	0.02	0.04	0.01	1.62
1983	0.11	0.13	0.06	0.01	0.02	0.38	2003	0.39	0.08	0.04	0.05	0.01	0.33
1984	0.12	0.12	0.11	0.00	0.03	0.24	2004	0.15	0.18	-0.06	0.01	0.00	0.55
1985	0.09	0.13	0.01	0.04	0.00	0.33	2005	0.14	0.15	0.06	0.10	0.01	0.34
1986	0.08	0.12	0.04	0.00	0.00	0.14	2006	0.12	0.57	0.02	0.05	0.00	0.34
1987	0.10	0.14	0.07	0.03	0.00	0.14	2007	0.19	0.15	0.02	0.02	0.00	-0.03
1988	0.07	0.11	0.04	0.02	-0.01	0.22	2008	0.19	0.16	0.01	0.03	0.01	-0.34
1989	0.08	0.20	0.16	0.12	0.00	0.39	1971-2008	0.13	0.17	0.04	0.03	0.01	0.189
1990	0.16	0.11	0.11	0.00	0.02	0.18	-	-	-	-	-	-	-

Source: Author's Calculations based on data from Economic Survey of Pakistan (Various Issues), State Bank of Pakistan (2005), World Development Indicators (various issues), Human Development Reports

The Total Factor Productivity has been computed on five yearly basis and for the whole period. The results show that TFP has been a very important contributor to economic growth. It contributed 59.8 % during 1971-1975. Its contribution remained 7.9 %, 32.9%, 13.6%, 42.8% and 39.3% during periods 1976-1980, 1980-85, 1986-1990, 1990-95 and 1996-00. The total factor productivity share remained very high during the period 2001-05 but it again exhibited a shock of 50% in next five years period. This means that only observed factors are not responsible for economic growth for Pakistan but also the unobserved factor played a significant role in economic growth of Pakistan. The overall contribution of Total Factor Productivity to growth rate of GDPPC in Pakistan remained 38.76% during the study period. The results are more or less similar to the estimates of Besudeb and Bari (2000), Ahmed *et al* (2007) and Ahmad (2007)[7]. The results are shown in Table 2.

Table 2 Total Factor Productivity during 1971-2008

Period	Contribution of factor inputs (%)			Total Factor Productivity	
	Capital	Labour	Human Capital	Estimate	Contribution (%)
1971-75	25.03	4.55	10.55	0.10416	59.86
1976-80	79.52	8.66	3.90	0.00966	7.92
1980-85	43.02	7.66	16.39	0.03688	32.93
1986-90	45.8	11.45	29.14	0.01334	13.61
1990-95	38.11	2.33	16.76	0.06078	42.80
1996-00	38.67	9.28	12.75	0.0503	39.30
2000-05	29.15	11.55	2.26	0.07388	61.57
2005-08	56.29	5.82	4.00	0.0576	33.88
1971-2008	43.15	7.62	10.46	0.0504	38.77

Source: Author's Calculations based on data obtained from Economic Survey of Pakistan (Various Issues), World Development Indicators, Sate Bank of Pakistan (2005). Note: The sum of percentage shares may possibly be not equal 100 as the figures are rounded off

[7] Ahmed (2007) derived the estimates for contribution of TFP as 36.61 percent for manufacturing sector and 33.86 for agriculture sector in Pakistan. Ahmad et al (2007) and Besudeb and Baari (2000) also derived more or less similar results for economy of Pakistan.

The share of TFP in GDP per capita growth shows high fluctuations, when the TFP is figured on five year basis. Therefore, decade wise TFP has also been computed. The sensitivity of TFP to human capital measures have also been analyzed by using education, health and R&D as proxies for human capital separately. The TFP has been estimated by using the following model.

$TFP= y-0.33\ k – 0.33\ l – 0.34\ h_c$

where 'y' shows the growth rate of GDP Per Capita, 'k', 'l' and 'h_c' are growth rates of physical capital, labour and human capital respectively. This model takes the optimum shares of capital and labour. The results have been displayed in Table 3. The fluctuations in TFP values seemed to be reduced when education was used as proxy for the human capital and the TFP was calculated decade wise. The maximum value of TFP remained 47.98 during 2001-2008 and the minimum value was 22.87 during 1981-90. The TFP has also been computed in similar fashion by using health has proxy for human capital instead of school enrollment. The contribution of TFP to GDP per capita increased when health was used as proxy for human capital.

The contribution of TFP to GDP per capita increased to 47.74% during the study period with health as measure of human capital. The fluctuation in TFP value, were also reduced as the extreme values remained 44.22% in 1981-90 and 47.32 in 2001-08. The contribution of health to GDP per capita growth remained very low with a range of 0.94% in 2001-08 to 1.65 in 1981-90. However the overall input of TFP to economic groth remained 47.74% in case of health as measure of human capital.

Research and Development is considered another form of human capital in New Growth Theories (NGT). When R&D was exercised as human capital, the TFP contribution knocked down to 18.27% during the study period. Interestingly, high jumps were noted in TFP when health was replaced by R&D. Surprisingly, the contribution of TFP seemed negative in the period 1981-90. The TFP remained very low with a value of 0.81% in 1971-80 but very high with a value of 47.76% in 2001-08. This high value may be to very huge investment in the R&D and higher education sectors during 2001-08.

The effects of factor shares on TFP were captured by incorporating two separate models for the estimation of TFP. In first model minimum possible share of the capital as 0.25 was taken. The model used in this case is given below

$TFP= y- 0.25k – 0.37l-0.38h_c$

Where, 0.37 is the labour share and 0.38 as human capital share.

The results are displayed in Table 4. The results show that the TFP contribution to GDP per capita growth rate increased to 46.72 % in case of Education and 57.08% in case of health during the study period. However, it remained 24.14 % during the same period in case of R&D. The share of Capital in GDP per capita growth decreased to 32.64 % during the study period. The contribution of labour and education also showed some improvement. This shows that the TFP is sensitive to capital share.

Table 3 Decade Wise Total Factor Productivity

Period	Contribution of Labour and Capital to GDP Per capita (%)		Contribution to GDP (Education as Human Capital) (%)		Contribution to GDP (Health as Human Capital (%)		Contribution to GDP (R&D as Human Capital) (%)	
	Capital	Labour	Education	TFP	Health	TFP	R&D	TFP
1971-80	46.93	6.78	7.67	38.62	1.64	44.65	45.48	0.81
1981-90	44.58	9.55	23.00	22.87	1.65	44.22	70.36	-24.49
1991-00	38.44	5.68	15.15	40.74	1.60	54.28	15.33	40.56
2001-08	42.37	9.37	0.27	47.98	0.94	47.32	0.49	47.76
1971-2008	43.09	7.72	10.72	38.47	1.45	47.74	30.93	18.27

Source : Author's Calculations based on data obtained from Economic Survey of Pakistan (Various Issues), World Development Indicators, State Bank of Pakistan (2005)

Table 4 TFP Model with Minimum Capital Share

Period	Contribution of Labour and Capital to GDP (%)		Contribution to GDP (Education as Human Capital) (%)		Contribution to GDP (Health as Human Capital (%)		Contribution to GDP (R&D as Human Capital) (%)	
	Capital	Labour	Education	TFP	Health	TFP	R&D	TFP
1971-80	35.55	7.60	8.57	48.28	1.84	55.01	54.04	6.02
1981-90	33.78	10.70	25.71	29.81	1.84	53.68	51.34	23.12
1991-00	29.12	6.37	16.93	47.58	1.78	62.73	44.26	47.39
2001-08	32.09	10.50	0.30	57.09	1.04	56.35	48.79	56.84
1971-2008	32.64	8.66	11.98	46.72	1.62	57.08	49.61	24.14

Source: Author's Calculations based on data obtained from Economic Survey of Pakistan (Various Issues), World Development Indicators, Sate Bank of Pakistan (2005). The formula used for calculation of TFP is TFP= y- 0.25k – 0.37l- 0.38hc

The share of capital if increased to 0.50 and shares of the labour and human capital decreased, TFP shows variation. This has been analyzed by using the following model.

$TFP = y - 0.50\,k - 0.25l - 0.25h_c$

The results are displayed in Table 5 which show that by taking maximum value of capital and minimum value of labour, the share of TFP declines from 46.72% (with capital share 0.25) to 20.99%, if education is used as human capital measure. The contribution of TFP is 27.80 % in case of Health and surprisingly, 6.13 % in case of R&D. the share of capital.

Conclusion and Recommendations

It is concluded on the basis of the results that TFP contributes 38.47% to the GDP growth rate of Pakistan. Among the set of factor inputs, the contribution of capital is highest and of labour is smallest. The contribution of TFP to the GDP growth rate depends on measure of human capital to a great extent which means that the contribution of TFP to economic growth of Pakistan is sensitive to the proxy for human capital. Similarly, TFP shows higher jumps in short periods but when calculated decade wise the fluctuations were controlled to some extent. Similarly, the share of factors is also an important determinant of TFP contribution to economic growth. The higher capital share leads to higher contribution of capital to economic growth and lower share reduces its contribution to economic growth. In short, it is concluded that the contribution of TFP to economic growth is sensitive to the measure of human capital, share of capital and length of period.

Acknowledgment: *The authors highly acknowledge the support and guidance of Dr. Davide Fiasche, Department of Economics, University of Pisa, Italy.*

Table V TFP with Maximum share of capital

Period	Contribution of Labour and Capital to GDP		Contribution of TFP to GDP with Education as Human Capital		Contribution TFP to GDP with Health as Human Capital		Contribution TFP to GDP with R&D as Human Capital	
	Capital	Labour	Education	TFP	Health	TFP	R&D	TFP
1971-80	71.11	5.13	5.64	18.12	1.21	22.55	33.44	- 9.68
1981-90	67.55	7.23	16.91	8.30	1.21	24.00	51.73	- 26.52
1991-00	58.24	4.30	11.13	26.32	1.18	36.29	11.27	26.19
2001-08	64.20	7.10	0.20	28.50	0.68	28.01	0.36	28.34
1971-2008	65.28	5.85	7.88	20.99	1.06	27.80	22.74	6.13

Source: Author's Calculations based on dataset of Economic Survey of Pakistan (Various Issues), World Development Indicators, Sate Bank of Pakistan (2005). The formula used for calculation of TFP is TFP= y-.50 k- 0.25l- 0.25h

References

Ahmad, K. (2007). *Sources of Growth and Total factor Productivity: A Case Study of Pakistan*, [Unpublished Ph. D Dissertation]. University of Punjab, Pakistan.

Ahmad K, M, A. Choudhry., & Ilyas, M. (2008). Trends in Total Factor Productivity in Pakistan Agriculture Sector. *Pakistan Economic and Social Review*, 46 (2), 117-132.

Bair, S., Dwyer, G.P., & Tamura, R. (2002). How important are Capital and Total Factor Productivity for Economic Growth, *Working Paper 2002-2a*, Federal Reserve Bank of Atlanta.

Barro, R. J. (1999). Notes on Growth Accounting. *Journal of Econ Growth*, *4*, 119-137.

Besudeb, G. K., & Bari, F. (2000). *Sources of Economic Growth in Asian Countries*. Global Research Project, World Bank.

Chen, E. K.Y. (1997). The Total factor Productivity Debate: Determinants of Economic growth in East Asia. *Asian Pacific Economic Literature, 11*(1), 18-39

Government of Pakistan. *Economic Survey of Pakistan* (various issues). Economic Advisors Wing, Ministry of Finance, Islamabad.

Iwata, S., Khan, M.S., & Murao, H. (2002). Sources of Economic growth in East Asia: A Non-Parametric Assessment. *International Monetary Fund Working Paper*, Wp/02/13.

Jorgenson, D. W., & Frauwani, B.M. (1992). Proceedings of Symposium on Productivity Concepts and Measurement Problems in Service Industries. *The Scandinavian Journal of Economics. 94*, S51-S70.

Jorgenson, D. W., & Griliches, Z. (1967). The Explanation of Productivity Change, *The*
Review of Economic Studies, 34 (3), 249-283.

Kendrick, J. W. (1961). *Productivity Trends in the United States*. Princeton University Press

Khan, S. (2006). Macro Determinants of Total Factor Productivity in Pakistan. *State Bank of Pakistan Research Bulletin*, l2 (2).

Nehru, V., & Dhareshwar, A. (1994). New Estimates of Total Factor Productivity for Developing and Industrial countries. *Policy Research Working Paper* 1313, International Economics Department, World Bank.

Nelson ,R. R., & Pack, H. (1999). The Asian Miracle and Modern Growth Theory.*The Economic Journal*, *109* (457), 416-436

Park, J. (2010). Projection of Long-Term Total Factor Productivity Growth for 12 Asian Economies. *Economics Working Paper Series*, Asian Development Bank, No. 227.

Sarel, M. (1997). Growth and Productivity in Asian Countries. *Working Paper No .ww/97/97*, International Monetary Fund

Sinhadji, A. (1999). Sources of Economic Growth: An Extensive Growth Accounting Exercise. *Working Paper No. WP/99/77*, International Monetary Fund

Solow, M. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics, 39* (3), 312-320.

State Bank of Pakistan (2005). *A Handbook of Statistics on Pakistan Economy*. Statistics and Data Warehouse Department.

United Nations Development Programme. (2008). *Human Development Report*. (UNDP), United Nations Organization World Bank, World Development Indicators (various Issues).

Young, A. (1992). A Tale of Two Cities: Factor Accumulation and Technical Change in Hong Kong and Singapore. *NBER Macroeconomics*, 7, 13-64.

Young, A. (1995). The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience. *The Quarterly Journal of Economics, 110*, 641-680.