*Research Report No. 68*

# DETERMINANTS OF TOTAL FACTOR PRODUCTIVITY IN PAKISTAN

SOCIAL POLICY AND DEVELOPMENT CENTRE

*Research Report No. 68*

# DETERMINANTS OF TOTAL FACTOR PRODUCTIVITY IN PAKISTAN

*By*

*Qazi Masood Ahmed and*
*Syed Kalim Hyder Bukhari*[1]

*June 2007*



[1] Qazi Masood Ahmed is Head of Research at the Institute of Business Administration (IBA), Karachi and Technical Advisor to the Social Policy and Development Centre (SPDC). Kalim Hyder is a Senior Economist at the Social Policy and Development Centre (SPDC).

# I. INTRODUCTION

The role of productivity in accelerating the pace of economic growth is well recognized in economic literature. In the neo-classical growth accounting framework, the growth of output is a summation of the growth of inputs accumulation and the growth of productivity or efficiency. Thus, for a given combination of factor inputs (capital, land and labor), the shifts in the production frontier are engendered by improvements in productivity or efficiency. In the neoclassical paradigm, efficiency or technological progress is being treated as an exogenous process, for example the Slow Growth Model (1956), Ramsay Optimal Growth Models (if these are the names of these models than they beginning letter of each word should be in caps – Ramsay Optimal Growth Models) (1928) and Samuelson Overlapping Generation Models, (1958) and their adherents. These models have been challenged by the endogenous growth theorists, who assume that the technological process is an endogenous process and can be quantified as Total Factor Productivity (TFP). The endogenous technological process allows government policies to affect technological process which in turn will be reflected in TFP and hence in growth. This means that there are several determinants that can affect output, although only indirectly, through affecting the efficiency of the capital and labor. In recent economic literature, specifically in developed and industrialized countries, several studies have attempted to examine the impact of macroeconomic policies on TFP growth [Englander, S. and Gurney, A. (1994); Edwards (1998); Miller and Upadhyay (2002)]. Several studies can also be referred to from developing economies [Golder and Kumari (2002); Hercowitz et al. (1999); Akinlo (2005)]. Few studies can also be cited from the Pakistan economy. However, the results are still not very conclusive.

This paper tries to highlight the effect of fiscal policy, monetary policy and other economic measures on TFP in Pakistan. Analyzing TFP in Pakistan by using recent data is important for two reasons. First, in the past few years, Pakistan has been experiencing very high growth in the region and it is important to know the latest growth accounting. Secondly, the Pakistan government has implemented many wide ranging economic reforms. These include reforms in exchange rate, interest rate as well as fiscal and monetary reforms since 1999-2000. It is important to know how these macro policy reforms have impacted TFP. These reforms are implemented with different vigor in different sectors therefore, the investigation of sector wise productivity is quite essential in order to explain the fluctuations of overall economic growth. The remaining paper is organized as follows: Section 2 reviews existing literature on the determinants of TFP; Section 3 explains the methodology used in the study; Section 4 discusses the trends in TFP and Section 5 highlights the contribution of determinants of TFP. Finally, Section 6 provides the policy implications of the results.

## II. REVIEW OF LITERATURE

In the neoclassical growth accounting framework, improvements in productivity or efficiency are treated as exogenous. According to the basic neoclassical model as expounded by Solow (1957), productivity evolves exogenously as determined by technology. However, the emergence of the new growth theories in the mid 1980s has reviewed the conventional neoclassical theory, to formally incorporate technical progress as the non-traditional determinants of economic growth. The endogenous growth models highlight the role of policy changes in affecting the efficiency of factors of production and TFP. The endogeneity of technological change is also discussed in the new international trade theory, which

explores the possibility of flow of FDI. This allows the transfer of technology which, can permanently raise growth rate and TFP. Romer (1992), Grossman and Helpman (1991), and Barro and Sala-I-Martin (1995), argue that the open economies have a higher probability to absorb technological advances generated in the leading nations. Coe and Helpman (1995), argue that the transfer of technology from advanced to developing countries through trade routes will be more successful in economies where education is wide and better spread. This lead the discussion to another class of growth models that postulate that the increase in productivity requires not only investment in physical capital but also in human capital. Education is critical to higher productivity in view of its complimentary effect. Several variables have been used in the literature to measure the impact of education. These include public expenditure on education as a percentage of GDP (Barro and Lee, 1994), and primary, secondary and higher school attainment (Sachs and Warner, 1995; Barro and Lee, 1994).

Initial research during the 1960s and the 1970s found that growth in developed countries was more due to increase in TFP than due to increase in factor inputs. For example, Kanamori (1972), showed that during 1955-1968, 60 percent of Japan's output growth was due to improvement in TFP. The literature on TFP also shows that technical efficiency has played an important role in TFP growth in developing countries. Yanrui Wu (1995), demonstrates that technical efficiency in state industry, rural industry and agriculture in post reform China was 50 to 60 percent during 1985-1991. Krugman (1994), argues that the source of growth for fast growing East and South East Asian economies was increase in factor inputs and therefore, not sustainable. Various studies have estimated that the contribution of TFP to growth ranged from a high of 41 percent in the case of Hong Kong and Taiwan, to 31 percent in Thailand, 26 percent in Indonesia, 24 percent in Singapore, 22 percent in Korea and a low of 11 percent in Malaysia and minus 8 percent in the case of the Philippines.

There has been limited research on trends in TFP in Pakistan. Wizarat (1988), showed that for the period from 1955-56 to 1980-81, TFP contributed only 7 percent to growth of the Large Scale Manufacturing (LSM) sector, despite the fact that the sector grew rapidly during this period. Pasha *et.al* (2002), Showed that the poor economic performance of the Pakistan economy during the 1990s was mainly due to slowdown in TFP. Ahmed and Sabir (2003), explored the impact of macro policies in determining TFP and found that stabilization policies negatively affected TFP in Pakistan.

## III. METHODOLOGY

Solow (1957), first proposed a growth accounting framework, which implied that part of growth in output, which cannot be explained by growth in factor inputs like land, labor and capital, can be attributed to TFP. Therefore, the aggregate production function is seen as follows:

$$Y = f(TFP, I)$$

where Y=output, I=factor inputs, TFP= Total Factor Productivity
this implies that

$$g_Y = g_{TFP} + g_I$$

where g is the growth rate
since $g_Y$ and $g_I$ are observed, then

$$g_{TFP} = g_Y + g_I$$

therefore, the growth in TFP is seen essentially as a residual.

## IV. TRENDS IN TFP

This section gives growth in Gross Domestic Product (GDP), growth of inputs and growth of TFP and the contribution of inputs and TFP in GDP growth for the economy as a whole and for individual sectors like agriculture, manufacturing, construction, electricity and gas distribution as well as services. Output growth is further detailed into TFP and the growth of conventional inputs such as capital, labor and land. (Appendix 1)

**Economy as a whole:**Economic growth shows significant variation over the study periods. The GDP attained a relatively high growth in the periods 1978-82, 1983-87, 1988-92, and 2003-06, whereas, during 1973-77, 1993-97 and 1998-02, it grew at lower rates (Annexure1 Table A). In Annexure 1 Table B, the annual average growth of the GDP at factor cost is broken down into two: growth due to increase in input availability and growth in TFP.

The contribution of TFP in achieving high growth varies from 5.6% in 1973-77 to 67.6% in 2003-06. During 2003-06, economic growth was mainly driven by the enhancement of TFP while lower growth during the 1970s and the 1990s were mainly a result of a massive decline in TFP. Similarly, high economic growth during the 1980s was somewhat equally contributed by availability of inputs and TFP. The growth rate of factor inputs has been derived on the assumption that the underlying production function is Cobb-Douglas Model in nature with constant returns to scale and neutral technical progress. This implies that the overall growth rate of factor inputs is the weighted sum of the growth rate of individual inputs of land, labor and capital, with the weights adding up to unity. The sector wise contribution in total economic growth is shown in Table A of Annexure I. The data are collected from the different issues of the Pakistan Economic Survey and the database of the Integrated Social Policy and Macroeconomic (ISPM) Model of the SPDC.

**Agriculture:** Pakistan is considered an agricultural country due to its fertile lands. The agriculture sector provides food to consumers, raw material to industries and exportable surplus which in turn provides valuable foreign exchange. Value added items of the agriculture sector were one third of the total GDP (factor cost) during the 1970s. The development of the industrial and services sector resulted in the decline of share of the agriculture sector and it now contributes almost one fourth towards the country's GDP (factor cost). At the same time, the agriculture sector absorbs almost half of the total employed labor force of the economy due to its labor intensive nature. Growth in this sector is highly dependent on climatic conditions. The contribution of input availability is not significant except early on in this study, which is the period from 1973-77. After that, it is TFP that drives growth in this sector. Lower investment and lack of land resources contributed insignificantly in the growth of the agriculture sector, however, labor has contributed reasonably in the growth of this sector. The period from 1988-92, which is known as another 'green revolution,' seems a result of TFP, as during this period, its contribution was 86.9 percent.

**Manufacturing:** The manufacturing sector has played a vital role in the development of the Pakistan economy. The emergence of agro-based industries has benefited the agriculture sector and has generated employment opportunities. The high economic period is consistent with better performance of the manufacturing sector. Input availability (2 percent to 3 percent) has not played any vital role in achieving higher growth in the manufacturing sector. The higher performance of the manufacturing sector is the result of changes in TFP. For example during 1977-92, its contribution remained between 60 percent and 70 percent and

during 2003-06, this went up to 80 percent. Whereas in the low growth period of 1993-97, its contribution was at 11 percent and in 1973-77 when the growth rate was 1.3 percent, its contribution was -107 percent.

**Construction:** Value added of the construction sector contributed on average 3 percent in the overall GDP during the study period. However, strong backward and forward linkages of this construction sector make this sector significant enough to be analyzed separately. Contribution of input availability and TFP towards the value added of construction sectors varies significantly over the sample period. TFP ranges from -12percent to 101percent. The negligible contribution of input availability during 1998-2006 is mainly due to the slowdown of investment activities in this sector.

**Electricity and Gas Distribution:** Energy is also an important sector of the Pakistan economy. This sector grew at a higher rate in all sub-periods except during 1998-02. Appendix 1 shows this sector has, in most of the period, negative contribution from TFP. The high growth of this sector, in most of the periods under review, was a result of high investment. During 1998-2002, when the growth of capital was negative, the real value added was also negative.

**Other Sectors:** Other sectors include, transport, storage and communication, wholesale and retail trade, finance and insurance, ownership of dwellings, public administration and defence as well as other services sectors. Under the category of "Other Sectors", contribution of TFP remained negative or negligible during 1973-2002 but increased to 31percent during 2002-06.

## V. DETERMINANTS OF TFP

**Economy as a whole:** The movements of TFP have a vital role to play in determining overall economic performance. So an effort has been made to find out the determinants of TFP.

**Overall Equation**

$$Ln\left(Y_{fc}^{r}\right) = \underset{(-4.61)}{-7.366} + \underset{(9.61)}{0.589}\,Ln(K^{r}) + \underset{(1.75)}{0.166}\,Ln(A) + \underset{(---)}{0.245}\,Ln(L) + \underset{(5.28)}{0.079}\,Ln(CPB)$$

$$+ \underset{(4.32)}{0.096}\,Ln(XMGR) + \underset{(3.00)}{1.377}\,Ln(HCI) + \underset{(3.61)}{0.055}\,Ln\left(\frac{DE}{PI}\right) + \underset{(3.01)}{0.017}\,Ln\left(\frac{CREDIT}{PI}\right) + \varepsilon_t$$

$R^2$ 0.999
D-W 1.85

**Diagnostics**

| Breusch-Godfrey Serial Correlation LM Test (Lag-1) | | | |
|---|---|---|---|
| F-statistic | 0.038474 | Probability | 0.846081 |
| Obs*R-squared | 0.052244 | Probability | 0.819204 |

| Wald Test: Null Hypothesis: 1-C(2)-C(3)=0 | | | |
|---|---|---|---|
| F-statistic | 5.238174 | Probability | 0.030468 |
| Chi-square | 5.238174 | Probability | 0.022096 |

where Yfc is real GDP at factor cost, K, A, L are capital, land and labor, respectively. CPB is cotton production, XMGR is export of manufactured goods, HCI is human capital index, DI/PI is real development expenditures and CREDIT/PI is real credit. All the statistical tests of the equations give satisfactory results and except in an area which is significant at 10 percent significance level, all other variables are significant at 1 percent and have expected positive signs, so the equation can be used for further analysis.

Based on the regression results, we are now in a position to quantify the contribution of diverse factors to the change in TFP in different periods. Cotton production, export of manufactured goods, human capital index[2], real development expenditures, real credit to private sector and other factors are the main determinants of overall TFP in Pakistan.

**TABLE 1**
**CONTRIBUTION OF IMPORTANT FACTORS IN TFP OF OVERALL ECONOMY**

| Years | GDP (FC) | TFP | Cotton Production | Export of Manufactured Goods | Human Capital Index | Real Development Expenditures | Real Credit to Private Sector | Other Factors |
|---|---|---|---|---|---|---|---|---|
| 1973-77 | 4.0% | 0.2% | -0.9% | -0.4% | 0.4% | 1.0% | 0.3% | -0.2% |
| 1978-82 | 6.6% | 2.8% | 0.8% | 0.7% | 0.4% | 0.0% | 0.0% | 0.8% |
| 1983-87 | 6.1% | 2.2% | 0.9% | 1.0% | 1.0% | 0.3% | 0.1% | -1.0% |
| 1988-92 | 5.5% | 2.4% | 0.8% | 0.9% | 0.1% | 0.1% | 0.0% | 0.4% |
| 1993-97 | 3.9% | 0.3% | -0.5% | 0.3% | 1.1% | -0.5% | 0.0% | -0.1% |
| 1998-02 | 3.5% | 1.0% | 0.2% | 0.8% | 0.2% | 0.2% | -0.5% | 0.1% |
| 2003-06 | 6.6% | 4.5% | 0.3% | 1.0% | 0.4% | 0.8% | 1.2% | 0.7% |

The results clearly show that the two most important factors which significantly affect TFP are cotton production followed by export of manufactured goods. In Pakistan more than 65 percent of exports are related to cotton (raw cotton and value added cotton). Therefore, cotton crop boom and crisis determine TFP significantly and consequently the GDP. In 2005, 45 percent of TFP was as a result of the cotton crop in that year (SPDC 2006). The contractionary fiscal policy (reduction in development expenditures) and also contractionary monetary policy (fall in the provision of real credit to private sector) were main factors in slowdown of TFP during 1992-2002. On the other hand, the higher contribution of TFP during the last four years was due to the expansionary fiscal policy (increase in public financing of development process) and expansionary monetary policy (increase in the real credit to private sector). Human capital index has also contributed positively and significantly in most of the sub-periods.

[2] Level of human capital embodied in the labor force, which has been proxied by the average number of years of schooling of employed persons

**Agriculture**

In the agriculture sector, the estimated equation is as follows:

$$Ln\left(Y_{ag}^{r}\right) = \underset{(-15.84)}{-19.149} + \underset{(2.57)}{0.053}* Ln(K_{ag}^{r}) + \underset{(5.73)}{0.566}* Ln(A) + \underset{(---)}{0.382}* Ln(L_{ag}) + \underset{(3.98)}{0.094}* Ln(CPB)$$

$$+ \underset{(1.88)}{0.041}* \Delta\left( Ln\left(\frac{ACD}{PI}\right)\right) + \underset{(15.63)}{5.126}* Ln(HCI) + \underset{(1.37)}{0.0214}* Ln\left(\frac{DEEP}{PI}*100\right) - \underset{(-8.65)}{0.105}* DWR + \varepsilon_t$$

$R^2$ 0.997
D-W 2.4

**Diagnostics**

| Breusch-Godfrey Serial Correlation LM Test (Lag-1) | | | |
|---|---|---|---|
| F-statistic | 1.294489 | Probability | 0.266454 |
| Obs*R-squared | 1.688832 | Probability | 0.193755 |

| Wald Test: Null Hypothesis: 1-C(2)-C(3)=0 | | | |
|---|---|---|---|
| F-statistic | 13.58045 | Probability | 0.001107 |
| Chi-square | 13.58045 | Probability | 0.000229 |

The subscript ag stands for agriculture sector. DEEP/PI is real development expenditure on economic services. The econometric results show that all variables have expected signs and except DEEP/PI, which is significant at lower level, all variables are significant at 1 percent level of significance.

Table 2 highlights the contribution of different factors to the growth of TFP in agriculture sector. Human capital improvement accounts for a significant contribution and highlights the importance of raising the human capital endowment of the labor force to achieve increases in TFP. The faster growth of TFP in recent years is due largely to the enhanced contribution of development expenditures on economic services by provinces. This shows that both physical capital and human capital are the main determinants of TFP in agriculture.

**TABLE 2**
**CONTRIBUTION OF IMPORTANT FACTORS IN TFP OF AGRICULTURE SECTOR**

| Years | Value Added in Agriculture Sector | TFP | Human Capital Index | Cotton Production | Agriculture Credit | Development Expenditures on Economic Services | Other Factors |
|---|---|---|---|---|---|---|---|
| 1973-77 | 3.7% | 1.0% | -0.6% | -1.7% | 0.3% | 0.2% | 2.8% |
| 1978-82 | 4.2% | 2.2% | 1.4% | 1.0% | 0.1% | 0.0% | -0.3% |
| 1983-87 | 3.7% | 2.5% | 3.9% | 1.1% | 0.0% | 0.2% | -2.7% |
| 1988-92 | 5.2% | 4.6% | 0.5% | 0.9% | -0.3% | 0.2% | 3.2% |
| 1993-97 | 3.4% | 2.4% | 4.1% | -0.6% | 0.0% | -0.3% | -0.8% |
| 1998-02 | 2.0% | 1.3% | 0.8% | 0.2% | 0.2% | -0.1% | 0.1% |
| 2003-06 | 3.9% | 2.8% | 1.6% | 0.4% | -0.4% | 0.8% | 0.4% |

**Manufacturing**

We now examine the factors contributing to the growth of TFP in the manufacturing sector. The estimated equation is as follows:

$$Ln\left(Y^{r}_{mn}\right) = \underset{(-16.25)}{-9.79} + \underset{(---)}{0.80} * Ln(K^{r}_{mn}) + \underset{(4.06)}{0.20} * Ln(L_{mn}) + \underset{(9.25)}{0.275} * Ln(XMGR)$$

$$+ \underset{(6.15)}{0.635} * (CU_{index}) + \underset{(4.53)}{0.293} * Ln(SPEIP + SPIEF) + \underset{(1.79)}{0.022} * Ln\left(\frac{Credit_{-1}}{PI_{-1}}\right) - \underset{(-6.68)}{0.167} * DUM_{73\text{-}80} + \varepsilon_t$$

$R^2$ 0.997
D-W 2.3

**Diagnostics**

| Breusch-Godfrey Serial Correlation LM Test (Lag-1) | | | |
|---|---|---|---|
| F-statistic | 0.780786 | Probability | 0.385320 |
| Obs*R-squared | 0.999424 | Probability | 0.317450 |
| Wald Test: Null Hypothesis: 1-C(2)=0 | | | |
| F-statistic | 271.6048 | Probability | 0.000000 |
| Chi-square | 271.6048 | Probability | 0.000000 |

The subscript mn denotes manufacturing sector. SPIEF and SPIEP are federal and provincial infrastructure and CU index is capacity utilization. The results show that all variables have correct expected sigh and significant. All variables except real credit are significant at 99 percent level of confidence.

Table 3 shows the determinants of TFP in the manufacturing sector of Pakistan. It shows that the exports of manufactured goods are the main determinants of TFP. In the four sub-periods when the TFP was very high, the contribution of manufactured growth was overwhelming. Similarly when the rate of increase in TFP was very low or negative, the role of manufactured exports was again dominating. The stock of provincial and federal infrastructure is another important determinant of TFP and has always contributed positively. The Pakistan economy faced a recession during 1998-2002, and capacity utilization rate went down significantly. During the recovery period (2002-06), the utilization rate of capacity increased significantly and contributed almost 40 percent in TFP.

**TABLE 3**
**CONTRIBUTION OF IMPORTANT FACTORS IN TFP OF MANUFACTURING SECTOR**

| Years | Value Added in Manufacturing Sector | TFP | Export of Manufactured Goods | Capacity Utilization | Stock of Provincial and Federal Infrastructure | Lagged Real Credit | Other Factors |
|---|---|---|---|---|---|---|---|
| 1973-77 | 1.3% | -1.4% | -1.0% | -2.9% | 4.1% | 0.1% | -1.7% |
| 1978-82 | 10.0% | 7.7% | 2.1% | -0.9% | 1.9% | 0.3% | 4.3% |
| 1983-87 | 7.4% | 4.6% | 2.7% | 0.8% | 1.3% | 0.3% | -0.5% |
| 1988-92 | 6.0% | 3.8% | 2.7% | 0.9% | 1.6% | -0.2% | -1.1% |
| 1993-97 | 3.0% | 0.3% | 0.7% | -2.1% | 1.2% | 0.3% | 0.2% |
| 1998-02 | 5.0% | 2.0% | 2.4% | -1.4% | 0.6% | -0.1% | 0.5% |
| 2003-06 | 10.0% | 8.0% | 2.9% | 3.2% | 0.5% | 0.9% | 0.5% |

**Construction Sector**

The regression for the construction sector is as follows:

$$Ln\left(Y_{cn}^{r}\right) = \underset{(-8.51)}{-6.066} + \underset{(4.68)}{0.685}^{*}\,\mathrm{Ln}(K_{cn}^{r}) + \underset{(---)}{0.315}^{*}\,\mathrm{Ln}(L_{cn}) + \underset{(1.90)}{0.055}^{*}\,\Delta\left(\mathrm{Ln}\left(\mathrm{RMC\$}_{me}\right)\right)$$

$$+ \underset{(1.48)}{0.041}^{*}\left(Advances_{cn}\right) + \underset{(2.84)}{0.180}^{*}\,\mathrm{Ln}(\mathrm{SPEIP}) + \underset{(3.22)}{0.149}^{*}\,\mathrm{Ln}\left(\frac{\mathrm{DE}}{\mathrm{PI}}\right) + \varepsilon_t$$

$R^2$ 0.99
D-W 1.4

**Diagnostics**

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|---|---|---|
| F-statistic | 1.315388 | Probability | 0.286310 |
| Obs*R-squared | 3.141990 | Probability | 0.207838 |

| Wald Test: Null Hypothesis: 1-C(2)=0 | | | |
|---|---|---|---|
| F-statistic | 4.655601 | Probability | 0.040012 |
| Chi-square | 4.655601 | Probability | 0.030952 |

The subscript cn is for the construction sector. Advances cn is total credit given to the construction sector and RMC$ me is the remittance in dollars from the Middle East. The results show that capital, provincial infrastructure and development expenditure are significant at 1 percent level of significance. Whereas, remittances, advance in construction sector are significant at 10 percent level of significance. All variables have expected positive signs.

The construction sector is an important sector in Pakistan's economy and perhaps has the most forward and backward linkages with other sectors. Therefore, when the government wants to pull the economy out of a recession or wants to increase economic activity, it tries to do it through the construction sector. TFP contributed 6.3 percentage points in the growth of the construction sector of 11.1percent during 1973-77 mainly due to increase in real development expenditures, stock of provincial infrastructure and bank advances. Similarly in 2003-06, when the government wanted to increase economic activity, it used the expansionary fiscal and monetary sector in the construction sector. In this period both these factors contributed almost 80percent in TFP of the construction sector.

**TABLE 4**
**CONTRIBUTION OF IMPORTANT FACTORS IN TFP OF CONSTRUCTION SECTOR**

| Years | Value Added in Construction Sector | TFP | Real Development Expenditures | Stock of Provincial Infrastructure | Remittances from Middle East | Bank Advances to Construction Sector (Public & Private) | Other Factors |
|---|---|---|---|---|---|---|---|
| 1973-77 | 11.1% | 6.3% | 3.0% | 4.2% | 0.9% | 1.3% | -3.1% |
| 1978-82 | 6.7% | 4.3% | 0.1% | 1.5% | -0.7% | 0.7% | 2.7% |
| 1983-87 | 5.1% | 0.7% | 0.7% | 1.2% | -0.3% | 1.2% | -2.1% |
| 1988-92 | 4.3% | 2.7% | 0.4% | 1.2% | -0.1% | -0.2% | 1.4% |
| 1993-97 | 2.5% | -0.3% | -1.4% | 0.9% | 0.1% | 0.5% | -0.5% |
| 1998-02 | 0.7% | 0.5% | 0.4% | 0.2% | 0.6% | 0.0% | -0.7% |
| 2003-06 | 4.6% | 4.6% | 2.3% | 0.2% | -0.5% | 1.4% | 1.2% |

**Electricity and Gas Distribution**

The regression for the Electricity and Gas Distribution sector is as follows:

$$Ln\left(Y_{eg}^{r}\right) = \underset{(-74.8)}{-1.731} + \underset{(29.55)}{0.704} * \text{Ln}(K_{eg}^{r}) + \underset{(---)}{0.296} * \text{Ln}(L_{eg}) + \underset{(2.16)}{0.253} * \Delta\left(\text{Ln}\left(\frac{DEF_{-1}}{PI_{-1}}\right)\right)$$
$$+ \underset{(5.17)}{0.037} * \Delta\left(\text{Ln}\left(FDI\$_{inflow}\right)\right) \underset{(-5.03)}{-0.353} * Dum_{02\_03} + \varepsilon_t$$

$R^2$ 0.99
D-W 1.6

**Diagnostics**

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|---|---|---|
| F-statistic | 0.941624 | Probability | 0.340802 |
| Obs*R-squared | 1.118417 | Probability | 0.290260 |

Wald Test: Null Hypothesis: 1-C(2)=0

| | | | |
|---|---|---|---|
| F-statistic | 153.9040 | Probability | 0.000000 |
| Chi-square | 153.9040 | Probability | 0.000000 |

The subscript eg is for the electricity and gas sector. DEF is lag of federal government expenditure and FDI is Foreign Direct Investment. The results show that the capital and federal development expenditure are significant at 1 percent level of significance. Whereas, FDI is significant at 5 percent level of significance. All variables have expected signs. This is an important sector in the sense that most of the time TFP in this sector is negative and mostly results in increase in capital stock and labor. Even in 2003-06, when the TFP was 7.2 percent, the variables used in the equation and alternative specifications did not explain.

**TABLE 5**
**CONTRIBUTION OF IMPORTANT FACTORS IN TFP OF ELECTRICITY AND GAS SECTOR**

| Years | Value Added In Electricity And Gas Distribution Sector | TFP | Real Development Expenditure Federal | Foreign Direct Investment | Other Factors |
|---|---|---|---|---|---|
| 1973-77 | 9.3% | -17.1% | 0.2% | -27.1% | 9.8% |
| 1978-82 | 8.2% | -5.7% | -0.6% | 0.5% | -5.6% |
| 1983-87 | 8.5% | -0.8% | -0.5% | -0.2% | -0.1% |
| 1988-92 | 12.1% | 1.8% | -0.5% | 0.3% | 2.0% |
| 1993-97 | 6.3% | -2.8% | 0.2% | -0.6% | -2.3% |
| 1998-02 | -0.1% | -2.0% | -0.2% | 0.7% | -2.4% |
| 2003-06 | 6.8% | 7.2% | 0.8% | 0.1% | 6.2% |

**Other Sectors**

$$Ln\left(Y_{ot}^{r}\right) = \underset{(-2.48)}{-3.187} + \underset{(20.41)}{0.913} * \text{Ln}(K_{ot}^{r}) + \underset{(---)}{0.087} * \text{Ln}(L_{ot}) + \underset{(8.59)}{0.617} * \Delta\left(\text{Ln}\left(\text{SPIEP} * \text{SPEIF}\right)^{\frac{1}{2}}\right)$$

$$+ \underset{(1.92)}{0.530} * \left(\text{Ln}(\text{HCI})\right) + \underset{(2.46)}{0.086} * \Delta\left(\text{Ln}\left(\frac{\text{DE}}{\text{PI}} * 100\right)\right) + \underset{(2.97)}{0.096} * \left(\frac{Trade}{GDP}\right) + \varepsilon_t$$

$R^2$ 0.99
D-W 1.9

**Diagnostics**

| Breusch-Godfrey Serial Correlation LM Test: | | | |
|---|---|---|---|
| F-statistic | 0.125835 | Probability | 0.725651 |
| Obs*R-squared | 0.158945 | Probability | 0.690130 |

| Wald Test: Null Hypothesis: 1-C(2)=0 | | | |
|---|---|---|---|
| F-statistic | 3.798115 | Probability | 0.061771 |
| Chi-square | 3.798115 | Probability | 0.051310 |

These sectors grew at an average rate of 5 percent during the last three decades. The growth rate ranges from 3.2 percent to 7.2 percent. However, the contribution of TFP remained negative or near zero in most of the sub-periods. Table 6 shows impact of declining growth of stock of federal and provincial infrastructure and significantly explains negative TFP. In the last sub-period of the study 2002-06, all the determinants of TFP i.e. stock of infrastructure both federal and provincial, remittances, human capital endowments of employed labor force, and trade openness have contributed positively in enhancing TFP.

**TABLE 6**
**CONTRIBUTION OF IMPORTANT FACTORS IN TFP OF OTHER SECTORS**

| Years | Value Added In Services Sector | TFP | Stock Of Provincial And Federal Infrastructure | Remittances | Human Capital Index | Trade to GDP Ratio | Other Factors |
|---|---|---|---|---|---|---|---|
| 1973-77 | 3.2% | -6.1% | -5.0% | 0.2% | -0.2% | 1.0% | -2.0% |
| 1978-82 | 7.2% | -1.8% | -2.5% | 0.1% | -0.2% | -0.1% | 0.9% |
| 1983-87 | 7.2% | 0.1% | -0.8% | 0.4% | 0.3% | -0.3% | 0.6% |
| 1988-92 | 5.5% | 0.0% | 0.7% | 0.1% | 0.0% | -0.3% | -0.4% |
| 1993-97 | 4.5% | -1.2% | -2.1% | 0.4% | -0.5% | 0.2% | 0.7% |
| 1998-02 | 4.0% | -0.8% | -0.4% | 0.1% | 0.6% | -0.1% | -0.9% |
| 2003-06 | 7.2% | 2.2% | 0.4% | 0.2% | 0.4% | 0.9% | 0.3% |

## VII. CONCLUSION AND POLICY IMPLICATIONS:

The role of productivity in accelerating the pace of economic growth is well recognized in economic literature and this paper shows that Pakistan's case is no exception. The purpose of the paper was also to see the effect of government fiscal policy, monetary policy and other economic measures on TFP. It shows that these policies affect TFP through human capital endowments of employed labor force, providing better physical infrastructure and other facilitation to incorporate technology in the production process.

Using data of the Pakistan economy from 1973 to 2006 both at aggregate and dis-aggregated levels i.e. Agriculture, Manufacturing, Construction, Electricity and Gas, and Other Sectors, the paper has tried to explain TFP for seven sub-periods equally divided into five years. The paper also explains very high growth in the last period (2002-06) and the impact of wide ranging economic reforms, including fiscal and monetary reforms, since 2000.

The contribution of TFP in achieving high growth varies from 5.6 percent during 1973-77 to 67.6 percent during 2003-06. During 2003-06, the economic growth was mainly driven by the enhancement of TFP and the lower growth during the 1970s and the 1990s was mainly due to a massive decline in TFP, whereas the high economic growth during the 1980s was to an extent equally contributed by inputs availability and TFP. [Appendix 1 Table B]

The aggregate equation results clearly show that two factors which significantly affect TFP are cotton production and the export of manufactured goods. In Pakistan, more than 65 percent per cent of exports are related to cotton and cotton products (raw cotton and value added cotton). Therefore, boom and crisis in the cotton crop, significantly determine TFP and consequently the GDP. In 2005, 45 percent of TFP was as a result of the good cotton crop in that year (SPDC 2006). The fiscal and monetary policy came out as significant factors deriving TFP both positively and negatively. The slowdown of TFP during 1992-2002 and higher TFP in the 2002-06 period was the result of the contractionary and expansionary fiscal and monetary policies, respectively.

The results of disaggregated equations show generally similar results as of aggregate equation but also reflect some sector specific factors affecting TFP. For example, human capital improvement accounts for a significant contribution in agriculture. This highlights the importance of raising human capital endowment and agricultural extension services to the labor force to achieve increases in TFP in this sector. The faster growth of TFP in recent years is attributed largely to the enhanced contribution of human capital in agriculture.

The results of the manufacturing equation show, like aggregate equation, that exports of manufactured goods and fiscal policy incentives are the main determinants of TFP. The stock of provincial and federal infrastructure is another more important determinant of TFP and has always contributed positively. This equation shows that during the recovery period 2002-06, the capacity utilization rate contributed almost 40percent in TFP.

The results of the construction sector equation show that during recovery periods this sector played an important role. The expansionary fiscal and monetary policy (increase in real development expenditures, stock of provincial infrastructure, and bank advances) during 1973-77 and 2003-06 were responsible for higher TFP. In the 2002-06 period, both these factors contributed almost 80 percent in TFP of the construction sector.

The equation of Electricity and Gas distribution and other sectors show inconclusive results. This is perhaps because in these sectors most of the time TFP were negative or near zero. "Other Sectors", however, show a declining growth of stock of federal and provincial infrastructure significantly which explains negative TFP.

Concluding this paper, we can say both fiscal and monetary policies are very important determinants of TFP in Pakistan. Factors like export of manufactured goods and human capital can also be improved through relevant fiscal and monetary policy initiatives. The paper concludes that fiscal policy both directly and indirectly, through improving human capital and physical capital, can increase TFP. This paper also shows that the macro economic reforms of the last ten years have contributed significantly in enhancing TFP and hence growth in recent years.

# REFERENCES


Anthony Enisan Akinlo (2005) Impact of Macroeconomic Factors on Total Factor Productivity in Sub-Saharan African Countries" Research Paper No. 39 UN-WIDER

Barro, R. J. (1990). 'Government spending in a simple model of endogenous growth'. *Journal of Political Economy* 98(5 part 2): S103-S125.

Barro, R. J. and Lee, J. (1994). 'International comparisons of educational attainments'. *Journal of Monetary Economics* 32: 363-94.

Barro, R. J. and Sala-I-Martin, X. (1995). *Economic Growth*. New York: McGraw-Hill.

Coe, D. T. and Helpman, E. (1995). 'International R&D spillovers'. *European Economic Review* 39: 859-87.

Cororation, C. B. (2004). 'National Report: Philippines', in *Measuring Total Factor Productivity: Survey Report*. Tokyo: Asian Productivity Organization.

Edwards, S. (1998). 'Openness, productivity and growth: What do we really know?' *Economic Journal* 108: 383-98.

Englander, S. and Gurney, A. (1994). 'Medium-term determinants of OECD productivity'. *OECD Economic Studies* 22: 49-109.

Goldar, B. N. and Kumari, A. (2002). 'Import liberalization and productivity growth in India industries in the 1990s'. *Working Paper* E/219/2002. Delhi: Institute of Economic Growth.

Griliches, Z. (1980). 'Returns to research and development expenditures in the private sector', in J. Kendrick and B. Vaccara (eds), *New Development in Productivity Measurement and Analysis*. Chicago: University of Chicago Press: pp. 419-54.

Griliches, Z. (1992). 'The search for R&D spillovers'. *Scandinavian Journal of Economics* 94(supplement): 29-47.

Griliches, Z. (1994). 'Productivity, R&D and the data constraint'. *American Economic Review* 84(1): 1-23.

Government of Pakistan (various Issues), Pakistan Economic Survey, Finance Ministry

Grossman, G. M. and Helpman, E. (1991). *Innovation and Growth in the Global Economy*. Cambridge MA: MIT Press.

Haddad, M. (1993). 'How trade liberalization affected productivity in Morocco'. *Policy Research Working Paper* 1096. Washington DC: World Bank.

Pasha, H.A., Aynul Hasan, and others 1996, Integrated Social-Sector Macroeconometric Model for Pakistan, Pakistan. Development Review, 35(4) 1996. PP 567-79

Hafiz, A. Pasha., Aisha, Ghaus-Pasha. and Kalim Hyder. (2002). "The Slowing Down of the Growth of Total Factor Productivity in Pakistan," Social Policy and Development Centre, *Research Report Number 44*.

Harrison, A. E. (1994). 'Productivity, imperfect competition and trade reform: Theory and evidence'. *Journal of International Economics* 36: 53-73.

Harrison, A. E. (1996). 'Openness and growth: A time-series, cross-country analysis for developing countries'. *Journal of Development Economics* 48: 419-47.

Hercowitz, Z., Lavi, Y., and Melnick, R. (1999). 'The impact of macroeconomic factors on productivity in Israel, 1960-96'. *Bank of Israel Economic Review* 72: 103-124.

Kanamori, H 1972. "What Accounts for Japan's High rate of Growth?", Review of Income and Wealth, 18(2), pp 155-71.

Khan, Safdar Ullah. (2006). "Macro Determinants of Total Factor Productivity in Pakistan," State Bank of Pakistan, *Working Paper Number 10*.

Kim, E. (2000). 'Trade liberalization and productivity growth in Korean manufacturing industries: Price protection, market power and scale efficiency'. *Journal of Development Economics* 62: 55-83.

Kim, K. W. (1994). 'Trade and industrialization policies in Korea: An overview', in G. K. Helleiner (ed.), *Trade Policy and Industrialization in Turbulent Times*. London and New York: Routledge, for UNU-WIDER.

Krugman, Paul. 1994 "The Myth of Asia's Miracle", Foreign Affairs, 73(6), pp 62.

Miller, S. M. and Upadhyay, M. P. (2000). 'The effects of openness, trade orientation, and human capital on total factor productivity'. *Journal of Development Economics* 63: 399-423.

Mohammad Sabir and Qazi Masood Ahmed. (2003). "Macroeconomic Reforms and Total Factor Productivity Growth in Pakistan: An Empirical Analysis," Social Policy and Development Centre, *Conference Paper No.55*

Ramsey, F. P. (1928). 'A mathematical theory of saving'. *Economic Journal* 38: 543- 59.

Romer, P. M. (1990). 'Endogenous technological change'. *Journal of Political Economy* 98(5): 71-102.

Romer, P. M. (1992). 'Two strategies for economic development: using ideas and producing ideas'. *World Bank Annual Conference on Economic Development*. Washington DC: World Bank.

Sachs, F. and Warner, A. (1995). 'Economic reform and the process of global integation'. *Brookings Papers on Economic Activity* 1995(1): 1-118.

Samuelson, P. A. (1958). 'An exact consumption-loan model of interest with or without the social contrivance of money'. *Journal of Political Economy* 66: 467-82.

Solow, R. M. (1956). 'A contribution to the theory of economic growth'. *Quarterly Journal of Economics* 70: 65-94.

Solow, R. M. (1957). 'Technical change and the aggregate production function'. *The Review of Economics and Statistics* 39: 312-20.

Wizarat, S. 1981 "Technological Change in Pakistan's Agriculture", Pakistan. Development Review, 20(4), 1981, pp 427-45.

Yanrui Wa (1995) "Productivity Growth, Technological Progress and Technical Efficiency change in China: A Three-sector Analysis" Journal of Comparative Economics, 21, 207-229.

# ANNEXURE I

| TABLE A | | | | | | | |
|---|---|---|---|---|---|---|---|
| Periods | Annual Average Growth of GDP (%) | Contribution of (% points) | | | | | |
| | | Agriculture | Manufacturing | Construction | Electricity and Gas Distribution | Services | Public Admn and Defense |
| 1973-77 | 4.1% | 0.8% | 0.3% | 0.3% | 0.1% | 1.9% | 0.7% |
| 1978-82 | 6.8% | 1.4% | 1.3% | 0.2% | 0.2% | 3.2% | 0.5% |
| 1983-87 | 6.3% | 1.1% | 1.1% | 0.2% | 0.2% | 3.3% | 0.5% |
| 1988-92 | 5.7% | 1.4% | 0.9% | 0.1% | 0.3% | 2.6% | 0.3% |
| 1993-97 | 4.0% | 0.9% | 0.5% | 0.1% | 0.2% | 2.1% | 0.2% |
| 1998-02 | 3.5% | 0.5% | 0.8% | 0.0% | 0.0% | 1.9% | 0.3% |
| 2003-06 | 6.8% | 0.9% | 1.8% | 0.1% | 0.2% | 3.6% | 0.3% |

| TABLE B<br>OVER ALL ECONOMY | | | | | | | |
|---|---|---|---|---|---|---|---|
| Periods | Annual Average Growth Rates (%) | | | Contribution of (%) | | | |
| | GDP (FC) | Input Availability | Total Factor Productivity | Total Factor Productivity | Capital Stock | Cultivated Area | Labor |
| 1973-77 | 4.0% | 3.8% | 0.2% | 5.6% | 71.2% | 3.4% | 19.8% |
| 1978-82 | 6.6% | 3.8% | 2.8% | 42.2% | 45.5% | 1.7% | 10.6% |
| 1983-87 | 6.1% | 3.9% | 2.2% | 36.4% | 52.1% | 1.3% | 10.2% |
| 1988-92 | 5.5% | 3.1% | 2.4% | 43.5% | 50.5% | 0.4% | 5.6% |
| 1993-97 | 3.9% | 3.5% | 0.3% | 8.7% | 70.1% | 3.7% | 17.6% |
| 1998-02 | 3.5% | 2.4% | 1.0% | 29.9% | 51.9% | 1.3% | 17.0% |
| 2003-06 | 6.6% | 2.1% | 4.5% | 67.6% | 23.0% | -0.3% | 9.7% |

| TABLE C<br>AGRICULTURE SECTOR | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Annual Average Growth Rates (%) | | | Contribution of (%) | | | |
| Periods | Value Added in Agriculture Sector | Input Availability | Total Factor Productivity | Total Factor Productivity | Capital Stock | Cultivated Area | Labor |
| 1973-77 | 3.7% | 2.7% | 1.0% | 27.1% | 35.4% | 8.3% | 29.2% |
| 1978-82 | 4.2% | 2.0% | 2.2% | 52.2% | 16.2% | 8.9% | 22.7% |
| 1983-87 | 3.7% | 1.3% | 2.5% | 66.4% | 14.2% | 7.3% | 12.0% |
| 1988-92 | 5.2% | 0.7% | 4.6% | 86.9% | 5.3% | 1.4% | 6.3% |
| 1993-97 | 3.4% | 1.0% | 2.4% | 71.0% | 3.8% | 14.0% | 11.1% |
| 1998-02 | 2.0% | 0.7% | 1.3% | 63.4% | 2.3% | 7.3% | 27.1% |
| 2003-06 | 3.9% | 1.1% | 2.8% | 71.6% | -1.1% | -2.0% | 31.4% |

| TABLE D<br>MANUFACTURING SECTOR | | | | | | |
|---|---|---|---|---|---|---|
| Periods | Annual Average Growth Rates (%) | | | Contribution of (%) | | |
| | Value Added in Manufacturing Sector | Input Availability | Total Factor Productivity | Total Factor Productivity | Capital Stock | Labor |
| 1973-77 | 1.3% | 2.8% | -1.4% | -107.7% | 130.3% | 77.3% |
| 1978-82 | 10.0% | 2.2% | 7.7% | 77.5% | 17.9% | 4.6% |
| 1983-87 | 7.4% | 2.8% | 4.6% | 62.6% | 29.0% | 8.4% |
| 1988-92 | 6.0% | 2.1% | 3.8% | 64.4% | 39.8% | -4.2% |
| 1993-97 | 3.0% | 2.6% | 0.3% | 11.0% | 85.5% | 3.4% |
| 1998-02 | 5.0% | 3.0% | 2.0% | 39.6% | 33.9% | 26.5% |
| 2003-06 | 10.0% | 2.0% | 8.0% | 79.9% | 15.3% | 4.8% |

| TABLE E<br>CONSTRUCTION | | | | | | |
|---|---|---|---|---|---|---|
| Periods | Annual Average Growth Rates (%) | | | Contribution of (%) | | |
| | Value Added in Construction Sector | Input Availability | Total Factor Productivity | Total Factor Productivity | Capital Stock | Labor |
| 1973-77 | 11.1% | 4.8% | 6.3% | 56.9% | 18.3% | 24.9% |
| 1978-82 | 6.7% | 2.4% | 4.3% | 64.4% | 17.0% | 18.7% |
| 1983-87 | 5.1% | 4.4% | 0.7% | 14.0% | 43.4% | 42.6% |
| 1988-92 | 4.3% | 1.6% | 2.7% | 62.6% | 20.5% | 16.9% |
| 1993-97 | 2.5% | 2.8% | -0.3% | -12.8% | 61.2% | 51.6% |
| 1998-02 | 0.7% | 0.1% | 0.5% | 80.6% | 7.4% | 11.9% |
| 2003-06 | 4.6% | 0.0% | 4.6% | 101.0% | -12.1% | 11.1% |

| TABLE F<br>ELECTRICITY AND GAS | | | | | | |
|---|---|---|---|---|---|---|
| Periods | Annual Average Growth Rates (%) | | | Contribution of (%) | | |
| | Value Added in Electricity and Gas Sector | Input Availability | Total Factor Productivity | Total Factor Productivity | Capital Stock | Labor |
| 1973-77 | 9.3% | 26.4% | -17.1% | -184.3% | 242.5% | 41.8% |
| 1978-82 | 8.2% | 14.0% | -5.7% | -69.6% | 119.8% | 49.8% |
| 1983-87 | 8.5% | 9.2% | -0.8% | -8.9% | 123.8% | -14.9% |
| 1988-92 | 12.1% | 10.2% | 1.8% | 15.2% | 78.3% | 6.6% |
| 1993-97 | 6.3% | 9.1% | -2.8% | -43.6% | 108.3% | 35.3% |
| 1998-02 | -0.1% | 1.9% | -2.0% | 1746.2% | -2117.3% | 471.1% |
| 2003-06 | 6.8% | -0.4% | 7.2% | 106.2% | 0.9% | -7.0% |

| TABLE G<br>OTHER SECTORS | | | | | | |
|---|---|---|---|---|---|---|
| | Annual Average Growth Rates (%) | | | Contribution of (%) | | |
| Periods | Value Added in Services Sector | Input Availability | Total Factor Productivity | Total Factor Productivity | Capital Stock | Labor |
| 1973-77 | 3.2% | 9.3% | -6.1% | -190.4% | 279.6% | 10.8% |
| 1978-82 | 7.2% | 9.0% | -1.8% | -24.4% | 120.4% | 4.1% |
| 1983-87 | 7.2% | 7.1% | 0.1% | 1.8% | 93.3% | 4.9% |
| 1988-92 | 5.5% | 5.4% | 0.0% | 0.8% | 94.8% | 4.4% |
| 1993-97 | 4.5% | 5.8% | -1.2% | -27.3% | 116.5% | 10.8% |
| 1998-02 | 4.0% | 4.8% | -0.8% | -20.2% | 114.7% | 5.5% |
| 2003-06 | 7.2% | 4.9% | 2.2% | 31.0% | 66.2% | 2.8% |