This study aims to consider as many reference points in time as possible within the range of 15 years from 1984-85 to 1999-2000. For this the years for which the Labor Force Surveys (LFS) were conducted were selected, so that the labor force data can be used directly from LFS reports. Consequently, four points in time are selected as reference points for this study:

i)   the year 1984-85

ii) the year 1989-90

iii) the year 1995-96

iv) the year 1999-2000

Adjustments required for each of these data points is summarized in Table 5.2.

Table 5.2

Adjustments required at different points in time

Ref. Point	Labor Force Data			Capital Stock Data		
	National	Agricult.	Division	National	Non-Agr.	Division
84-85	Adjusted	Adjusted	Adjusted			
89-90	Assumed	Assumed	Assumed			
95-96			Adjusted	Estimated	Estimated	Estimated
99-00			Adjusted			

Note:

Ref.   reference

Adjusted.   data is adjusted for the purpose of the study

Assumed.   data for calendar year is assumed applicable for financial year

Estimated.   data is estimated from data of other years

(blank cell) data is used directly from the mentioned sources

Agricult.   agricultural sector

Non-Agr.   non-agricultural sector

Since the selection of the points of reference in time is constrained by limitations of data, the selection involved consideration of as many years as possible from the points for which all the relevant data are available. Fortunately, the reference

points provide three sub-periods of similar intervals. Four intervals in total are considered in this study:

    i)   Sub-period-1, from 1984-85 to 1989-90

    ii) Sub-period-2, from 1989-90 to 1995-96

    iii) Sub-period-3, from 1995-96 to 1999-2000

    iv) Whole period, from 1984-85 to 1999-2000

5.5 Data Collection

5.5.1   Data Requirements

The variables used in this study are as follows:

    i)   Gross Domestic Product at Constant Market Prices (in million taka)

    ii) Cultivated Agricultural Land (in thousand acres)

    iii) Non-Agricultural Capital Stock (in million taka)

    iv) Employed Labor Force (in thousand persons)

    v) Factor Income Shares (in percentage)

The data should be available for the following units of observation:

    i)   the Aggregate National Level

    ii) the two major sectors:

        a) the Agricultural sector

        b) the Non-Agricultural sector

    iii) the six administrative divisions:

        a) Barisal

        b) Chittagong

        c) Dhaka

        d) Khulna

        e) Rajshahi

        f) Sylhet

5.5.2 Gross Domestic Product as an Output variable

The most commonly used variable in assessing the total value of goods and services produced by a nation in a given period is GDP. This study uses GDP at constant prices as a measure of output. GDP data for Bangladesh economy is available from various issues of the Statistical Yearbook of Bangladesh. Table 5.3 shows GDP at constant 1984-85 prices at aggregate level, for the major sectors, and for the divisions. GDP for each division is obtained by summing up GDP figures of all districts under the jurisdiction of that particular division.

Table 5.3

Gross Domestic Product at constant 1984-85 prices (million taka)

Year	By Sector		By Division						Natio-
	Agricult ural	Non- agr.	Bari- sal	Chitta- gong	Dhaka	Khulna	Rajshahi	Sylhet	nal
84-85	169970	237167	27291	97970	119072	51755	94074	26621	**407137**
89-90	190354	307173	37424	117701	145108	61337	102844	31385	**497527**
95-96	207126	435315	42335	152415	191577	79070	131573	42162	**642441**
99-00	259445	547183	51962	194045	239047	101073	162391	52965	**806628**

Note:

Non-Agr. = non-agricultural sector

5.5.3 Cultivated Agricultural Land as an Input variable

In the industrialized countries, land is usually regarded as a fixed factor of production and therefore ignored in the productivity analysis. But as land is an important factor in agricultural production in countries like Bangladesh and since land utilization statistics for this country shows a slight increase in total cropped area with time, the variable land is considered in this study as an input factor. In this study, the 'total cropped area' is the sum of the 'net cropped area' and the 'area sown more than once'. Here, 'net cropped area' refers to the total area brought under cultivation at

least once in the year, whereas 'area sown more than once' refers to the total area sown for the second time plus the total area sown for the third time. However, only the agricultural sector land is considered for the analysis. Data on the total cropped area is obtained from reports on various agricultural censuses and shown in Table 5.4.

Table 5.4

Total cropped area in Bangladesh (acres)

Year	By Division						National
	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Sylhet	
84-85	2691	4851	8920	3880	9935	2219	**32496**
89-90	3237	5346	9064	4739	9910	2452	**34750**
95-96	2990	4995	8762	4544	9624	2476	**33391**
99-00	3023	5174	9150	4695	10763	2462	**35267**

5.5.4   Capital Stock as an Input variable

Capital is an important input in the process of production and its contribution to the growth of output should be increasing as a country moves from the labor-intensive technology to the capital-intensive one. Two types of capital can be considered for the purpose of this study – agricultural sector capital and non-agricultural sector capital.

It can be mentioned here that, the agriculture in Bangladesh is still predominantly human-labor based and non-mechanized. Tools like sickle, curved knife, wooden plough, etc. are used in most cases with draught animals. About half of the area irrigated is covered by engine-powered irrigation and also an insignificant portion of the land is cultivated using tractors. As data on irrigation pumps and land tractors are not available, capital stock for agricultural sector cannot be measured for the purpose of this study. On the other hand, data on livestock population is available for only two points in time (1983-84 and 1995-96) and also information on the

percentage of cattle used in cultivation is not complete. Hence, this study cannot consider agricultural capital stock in the analysis.

In the absence of agricultural capital stock data, only the non-agricultural capital stock will be considered in this study, and consequently this non-agricultural sector capital will be treated as the total capital stock for the whole economy too. Then again, since no data on non-agricultural capital stock is available from the national accounts in Bangladesh, this study has to rely on some other sources and some other relevant data. The following sources are used by this study in this regard.

i) BBS publishes the public and private investment at current prices in the National Production Account. This investment account includes investment in construction, investment in machinery, and investment in transport equipment. With a base year for which the stock of capital is known, a capital stock series can be generated with perpetual inventory method using this information on investment.

ii) The Census for Manufacturing Industries (CMI) of Bangladesh provides for the manufacturing sector a gross book value of fixed assets net of depreciation allowances and investment figures, both for the divisions and for the whole economy. But this covers only the manufacturing sector and hence cannot be used in this study.

iii) Nehru and Dhareshwar (1993) estimated capital stock for 93 countries of the world including Bangladesh for the years from 1960 to 1990 using perpetual inventory method, which is shown in Table 5.5. This data set has been used in several working papers of World Bank and considered as the best among currently available data sets (Papageorgiou, 2003). This series, however, cannot be used directly in this study since it is available up to only 1990.

iv) Marquetti (2004) estimated a series of capital stock for many countries including Bangladesh in the Extended Penn Worlds Table Version-2.1 (EPWT-2.1) using perpetual inventory method. For Bangladesh, a net fixed standardized capital stock series has been estimated for the years from 1971-72 to 1999-2000. This data on capital stock is shown in Table 5.5. As this series is available in USD at constant 1996 prices,

the figures are converted to local currency using year-average standard conversion rate for the year 1995-96 (IMF CD-ROM version 1.1.55) and then converted to 1984-85 prices using wholesale price indices for capital goods. However, this data set cannot be used for the purpose of this study for two reasons. First, if compared with the more popular data set of Nehru and Dhareshwar (1993), EPWT-2.1 figures appear to be too high. The difference can be observed from Table 5.5. Second, although this kind of data set has been extensively used in many cross-country studies, its use in country specific studies is seldom observed. For example, the use of a single common depreciation rate in the capital stock estimates using perpetual inventory method has been criticized in the literature (Bu, 2004). Also, the rate of depreciation considered in this estimate is too high (7.5% per annum) if compared with other estimates.

v) Alam et al. (2005) obtained public and private capital stock including both manufacturing and service sectors from the industrial census reports for their study on impact of transport investment for the regions in Bangladesh. Fortunately, this data is available for the purpose of this study as shown in Table 5.6. Since this data is available at current market prices, it is converted to constant 1984-85 prices.

Table 5.5 compares capital stock data for Bangladesh at 1984-85 prices from various sources. The difference in the capital stock data in different studies may be due to difference in assumption of initial capital stock, or due to difference in assumption of rate of depreciation.

This study uses Alam et al. (2005) data set, as shown in Table 5.6, for calculating TFPG at the aggregate national level, for the non-agricultural sector, and for the divisions. The main reason of using this data set is that the data is available at the division level enabling regional productivity analysis. No other data set contains data for the regions of Bangladesh. There are, however, specific limitations of the capital stock data from Alam et al (2005). So, measures have to be taken to overcome the limitations. Some measures which are followed in this study are discussed below.

Table 5.5

Comparing national capital stock series from different sources

Year	EPWT-2.1 Capital [a c]			N-D Capital [a d]		Alam et al. Capital [e]	
	96 price (mill.USD)	95-96 price [b] (mill.tk.)	84-85 price (mill.tk.)	86-87 price [b] (mill.tk.)	84-85 price (mill.tk.)	Current price (mill.tk.)	84-85 price (mill.tk.)
84-85	76502.87	3197376	**1872623**	935214	**815047**	260055	**260055**
85-86	80367.08	3358878	**1967210**	959263	**836005**	n.a.	**n.a.**
86-87	84133.72	3516302	**2059409**	988469	**861459**	n.a.	**n.a.**
87-88	88045.82	3679805	**2155169**	1017418	**886688**	n.a.	**n.a.**
88-89	92237.20	3854980	**2257764**	1039595	**906016**	n.a.	**n.a.**
89-90	96274.68	4023723	**2356593**	1062053	**925588**	391079	**286711**
90-91	99831.82	4172391	**2443664**	n.a.	**n.a.**	n.a.	**n.a.**
91-92	102873.37	4299510	**2518115**	n.a.	**n.a.**	n.a.	**n.a.**
92-93	106351.14	4444861	**2603243**	n.a.	**n.a.**	n.a.	**n.a.**
93-94	109488.45	4575982	**2680037**	n.a.	**n.a.**	n.a.	**n.a.**
94-95	113709.39	4752393	**2783356**	n.a.	**n.a.**	649441	**369152**
95-96	119192.77	4981566	**2917578**	n.a.	**n.a.**	n.a.	**n.a.**
96-97	126987.75	5307351	**3108382**	n.a.	**n.a.**	n.a.	**n.a.**
97-98	136474.97	5703862	**3340608**	n.a.	**n.a.**	n.a.	**n.a.**
98-99	147051.11	6145883	**3599489**	n.a.	**n.a.**	n.a.	**n.a.**
99-00	158696.77	6632604	**3884549**	n.a.	**n.a.**	875767	**435976**

Note:

A   Calendar year data is assumed as data for financial year ended in middle of same calendar year

B   Calendar year price is assumed as price for financial year ended in middle of same calendar year

C   This capital stock data is obtained from Extended Penn World's Table constructed by Marquetti (2004) and converted to local currency using year average conversion rate from database of IMF CD-ROM version 1.1.55

D   This capital stock data is obtained from Nehru and Dhareshwar (1993)

E   This capital stock data is obtained from Alam et al. (2005)

First, the capital stock figures from different data sets have to be converted to a constant 1984-85 price series and for that a series of deflators is estimated. This study uses wholesale price indexes for capital goods to estimate the deflators, the procedure of which is described in details in Appendix A.

Second, capital stock figures has to be estimated for some missing years for both data sets and for that a model has to be developed. This study uses Perpetual Inventory Method (PIM) model suggested by Nehru and Dhareshwar (1993) for such estimation. The model is described in details in Appendix A.

Third, the Alam et al. (2005) data does not include the year 1995-96, one of the reference points in time considered in this study. The capital stock for this year has to be estimated using 1994-95 value of Alam et al. (2005) data set and the investment information from national census. The procedure of estimation is described in details in Appendix A. The resulting set of data to be used in the analysis is shown in Table 5.6.

Table 5.6

Final set of Capital Stock data (million taka) for the analysis

Year	By Division						National
	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Sylhet	
84-85	5501	103269	89662	16397	36561	8665	**260055**
89-90	6053	103801	107184	17264	41946	10463	**286711**
95-96 [a]	7561	130097	121043	57325	50643	16483	**383153**
99-00	13228	129789	158905	55044	58347	20663	**435976**

Note:

a   Data for this year is estimated from 1994-95 data using national investmetn series

5.5.5   Labor as an Input Variable

Labor is a very important input for any production system. Labor Force Surveys (LFS) in Bangladesh define the economically active population as the total of employed and unemployed population. This study considers only the employed portion of the economically active population of age 10 years and above as the labor input in the production process. This study excludes population of age 9 years and below, inactive persons and persons engaged in works that are not considered formally productive. Labor force data for Bangladesh is obtained from reports on various labor force surveys.

LFS, the only reliable source of data on labor force in Bangladesh, is conducted in a discontinuous manner for the years 1981, 1983-84, 1984-85, 1985-86, 1989, 1990-91, 1995-96 and 1999-2000. However, there are several problems associated with the data from this source.

  i) The data from these surveys are discontinuous with unequal intervals, so that only few points can be considered as reference points in this study.

  ii) Divisions do not report 'employed' labor force, but reports only 'economically active' labor force which includes both 'employed' and 'unemployed' portions of the labor force. But since this study considers the 'employed' portion of the labor force, 'employed' labor force for every division has to be estimated using national employment rate.

Besides, there are specific limitations of data from certain surveys. Special measures have to be taken to overcome the limitations and figure out reliable sets of labor force data for the analyses.

First, 1984-85 LFS considered a major portion of unpaid family helper (UFH) category as inactive population, so that the UFH portion of this survey has to be adjusted to make figures from this survey consistent with the definition of other surveys considered in this study. The procedure of adjustment for this year is shown in Appendix B.

Second, 1989 LFS is conducted for calendar year, whereas the others are conducted or financial years. Since the other variables for this study are reported for financial years, the data from LFS 1989 has to be considered as data for the financial year 1989-90. Besides, this LFS reports for the four former administrative divisions of the country and not for the six new administrative divisions, so that data for the new divisions has to be estimated. The procedure of adjustment for this year is shown in Appendix B.

Third, 1995-96 LFS reports for all age groups starting from age 10 years at the national level, whereas it reports for labor force of 15 years and over at the division level. Hence the divisional labor force for the age group 10-14 has to be estimated from the national figure of labor force of the same age group. The procedure of adjustment for this year is shown in Appendix B.

Table 5.7

Final set of data on the Employed Labor Force (thousands)

Year	By Division [d]						National
	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Sylhet	
84-85 [a]	3271	8831	13965	5658	10538	2801	**45064**
89-90 [b]	3793	9411	15184	6448	12209	3102	**50147**
95-96 [c]	6489	9574	14821	7021	13347	3344	**54597**
99-00	5710	10849	17034	7174	14013	3286	**58067**

Note:

a   Data for this year is adjusted for unpaid family helper category

b   Data for this year is taken from the calendar year survey for 1989 and data at the division level is estimated for the new divisions

c   Data for this year is estimated at division level for the age group 10-14 years

d   all LFS data of economically active population for the divisions are reduced by unemployment rate of the same year to get the employed labor force volume from

Fourth, 1999-2000 LFS data has to be adjusted only at the division level to estimate the employed labor force. The procedure of adjustment for this year is shown in Appendix B.

The final set of data for the employed labor force of Bangladesh after all adjustments is presented in Table 5.7.

5.5.6   Factor Income Share

Factor income share data is needed for measuring TFPG at the aggregate national level and for the major sectors. But this data is not available from the national accounts of Bangladesh. Bangladesh adopted SNA-93 for constructing yearly national accounts, but the implementation of the standard is not yet complete. Hence, information on the factor income shares has to be obtained from other sources. In similar situation in case of India, the value share of labor was assumed to be 0.70 and that of capital to be 0.30 and both to be constant for the years 1970, 1975 and 1980 in the study by Ikemoto (1986). However, recently SAM 1993-94 has been constructed in Bangladesh. The information on factor income shares will be obtained from this SAM for the purpose of this study and these shares will be assumed to be constant throughout the entire period of this study, i.e. from 1984-85 to 1999-2000. These shares are shown in Table 5.8.

Table 5.8

Factor Income Shares as per SAM 1993-94

Factor	Agricultural (bill.tk.)	Non-Agr. (bill.tk.)	Total (bill.tk.)	Agricultural (%)	Non-Agr. (%)	Overall (%)
Labor	115.594	426.862	542.456	**41.836**	**44.052**	**43.560**
Land	160.711	0.000	160.711	**58.164**	**0.000**	**12.905**
Capital	0.000	542.143	542.143	**0.000**	**55.948**	**43.535**

Note:

Agr. Agricultural

It should be mentioned here that, rent to capital for the agricultural sector is zero in SAM 1993-94 and rent to land for the non-agricultural sector is zero on the other hand. Hence, this study has to exclude the capital input factor from the agricultural sector analysis and the land input factor from the non-agricultural sector analysis. Exclusion of capital in the agricultural sector productivity analysis stems from the assumption of nil effect of capital growth on agricultural output growth. In the same way, exclusion of land in the non-agricultural sector productivity analysis stems from the assumption that growth in land does not contribute to growth in non-agricultural sector output.