APPENDIX A

ESTIMATION OF CAPITAL STOCK DATA

Limitations of the Capital Stock data

This study conducts its analysis using the capital stock data obtained by Alam et al. (2005). This data set has some limitations:

i) This data is not continuous and available at five years interval from 1974-75 to 1999-2000 for only six points in time, so that data is not available for one reference points in time considered in this study (the year 1995-96) and data for this year has to be estimated.

ii) This data set is available at current market prices, so that it has to be converted to constant 1984-85 prices.

Hence, the estimation of required data will involve the following steps:

i) Construction of a series of deflators for converting all relevant data to a constant price series

ii) Development of a Perpetual Inventory Method model for estimating capital stock data for the missing years

iii) Estimation of 1995-96 data taking the 1994-95 value of capital stock in the Alam et al. (2005) series as the base year capital and adding with it the investment made in capital and machinery at the national level in 1994-95.

Estimation of Deflators for Yielding Constant Prices Series

This study uses wholesale price indexes for capital goods for construction of a series of deflators for yielding a constant price series of capital stock. Such a construction of the deflators is shown in Table A1.

The second and the third column of the table show that, the wholesale price index for capital goods is available in two series from the national publications:

i) From 1972-73 to 1989-90, the wholesale price index is available at base year 1973-74.

ii) From 1988-89 to 2003-04, the wholesale price index is available at base year 1988-89.

Hence, two of the years are common in both of the series', the years 1988-89 and 1989-90. This common platform is used to construct a single series at 1988-89 base from 1984-85 to 1999-2000, as shown in the fourth column of the table. This unified series at 1988-89 price is then converted to a 1984-85 price series, as shown in the fifth column of the table. The procedure is as follows.

First, the 1988-89 figure is taken as 100 in the 1973-74 series and the other figures of the same series reduced in the same proportion, resulting in a unified series at 1988-89 base. This unified series is shown in the fourth column of the table.

Second, the 1984-85 figure is taken as 100 in the unified 1988-89 series and the other figures of the same series increased in the same proportion, resulting in a unified series at 1984-85 base. This unified series is shown in the fifth column of the table.

Table A1

Wholesale Price Indexes for Capital Goods

Year	73-74 base	88-89 base Original	88-89 base Estimated [a]	84-85 base Estimated [b]
1984-85	**312.00**	**n.a.**	**84.10**	**100.00**
1985-86	337.00	n.a.	90.84	108.01
1986-87	358.00	n.a.	96.50	114.74
1987-88	351.00	n.a.	94.61	112.50
1988-89	371.00	100.00	n.a.	118.91
1989-90	**381.00**	**114.71**	**n.a.**	**136.40**
1990-91	n.a.	120.35	n.a.	143.11
1991-92	n.a.	139.58	n.a.	165.97
1992-93	n.a.	135.29	n.a.	160.87
1993-94	n.a.	140.72	n.a.	167.33
1994-95	n.a.	147.95	n.a.	175.93
1995-96	**n.a.**	**143.59**	**n.a.**	**170.74**
1996-97	n.a.	146.82	n.a.	174.58
1997-98	n.a.	149.40	n.a.	177.65
1998-99	n.a.	146.26	n.a.	173.92
1999-00	**n.a.**	**168.93**	**n.a.**	**200.88**

Note:

a Value is estimated from 1973-74 base series assuming 1988-89 value as 100 and other values changed proportionately

b Value is estimated from 1988-89 base series assuming 1984-85 value (estimated from 73-74 series) as 100 and other values changed proportionately

Model for Estimation of Capital Stock data

Once the deflators are calculated, this study uses perpetual inventory method to estimate the capital stock data for the years that are covered neither by Nehru and Dhareshwar (1993) nor by Alam et al. (2005). This study uses for this purpose the same model as used by Nehru and Dhareshwar (1993) and assumes the same rate of depreciation, which is 4%, per annum.

The mentioned model follows from the logic that, the capital stock of a year is the sum of depreciated real capital stock of previous year and the real investment made in the previous year. The model is described below.

For year 1, $\quad K_1 \ = \ (1-\lambda)^0 \, I_0 + (1-\lambda)^1 \, K_0$

For year 2, $\quad K_2 \ = \ (1-\lambda)^0 \, I_1 + (1-\lambda)^1 \, I_0 + (1-\lambda)^2 \, K_0$

For year 3, $\quad K_3 \ = \ (1-\lambda)^0 \, I_2 + (1-\lambda)^1 \, I_1 + (1-\lambda)^2 \, I_0 + (1-\lambda)^3 \, K_0$

For year t, in the same way,

$$K_t = \sum_{i=0}^{t-1} (1-\lambda)^i \cdot I_{t-i} + (1-\lambda)^t \, K_0 \qquad\qquad \text{(A1)}$$

where, K_t = capital stock t years after the base year

K_0 = year-end position of the capital stock of the base year

λ = assumed rate of depreciation, here 4% per annum

I_{t-1} = investment made in the year $t-1$

Estimation of Capital Stock for the Main Analysis

Three steps are followed to get the required capital stock data for the main analysis. An important step in this process is to estimate the capital stock data for the year 1995-96.

First, the data from Alam et al. (2005) is converted from a current price series to a constant 1984-85 price series. The conversion is shown in Table A2. Salim and Kalirajan (1999) have employed the same technique of conversion in their study on Bangladesh food processing industries.

Second, the non-agricultural capital stock data is estimated for the year 1995-96 using the model A1. Here, base year is the year 1994-95, initial stock of capital is the real capital stock from Alam et al. (2005) for the year 1994-95, and investment is the real investment in machinery and equipment made in the year 1994-95, with a depreciation rate of 4% applied as suggested by Nehru and Dhareshwar (1993). The resulting estimate for the year 1995-96 is shown in Table A3.

Third, since there is no way of doing the same kind of estimations for the division level capital stock due to unavailability of investment series for the divisions, the 1994-95 data for every division is increased arbitrarily by 3.79% to get the 1995-96 value as shown in Table A4. It can be seen from the table that the estimated national capital stock for the year 1995-96 is 3.79% higher than the obtained national capital stock for the year 1994-95. This is the reason why this study increases the capital stock for the year 1994-95 of every division by 3.79% to get the corresponding figures of 1995-96.

Table A2

Conversion of Non-Agricultural Capital Stock data to constant prices

Units of Observation	Current Price [a] (mill.tk)				Constant 1984-85 Price (mill.tk)			
	1984-85	1989-90	1994-95	1999-00	1984-85	1989-90	1994-95	1999-00
Dhaka	89662	146201	205167	319200	89662	107184	116620	158905
Chittagong	103269	141586	220513	260714	103269	103801	125343	129789
Sylhet	8665	14272	27939	41507	8665	10463	15881	20663
Rajshahi	36561	57215	85840	117205	36561	41946	48793	58347
Khulna	16397	23549	97166	110569	16397	17264	55231	55044
Barisal	5501	8256	12816	26572	5501	6053	7285	13228
Bangladesh	**260055**	**391079**	**649441**	**875767**	**260055**	**286711**	**369152**	**435976**

Note: a   Data obtained from Alam et al. (2005)

Table A3

Estimation of national capital stock data for the year 1995-96

Year	Capital Current Prices (mill.tk.)	Investment Current Prices (mill.tk.)	Deflator (84-85 base)	Capital 84-85 Prices (mill.tk.)	Investment 84-85 Prices (mill.tk.)	End-year Cap. net of depr. [a][b] (mill.tk.)
1994-95 [c]	649441	50609	175.93	369152	28767	383153

Note:

a depreciation rate 4% per annum assumed as in Nehru and Dhareshwar (1993)

b this figure is assumed to be capital stock for the next year

c end-year capital for 1994-95 is the capital stock for the year 1995-96

Table A4

Estimation of divisional capital stock data for the year 1995-96

Units of Observation	1994-95 Capital (mill.tk.)	1995-96 Estimated [a] (mill.tk.)	Observed Increase in 1995-96 (%)	Assumed Increase in 1995-96 (%)	1995-96 Estimated [b] (mill.tk.)
Dhaka	116620	n.a.	n.a.	3.79	121043
Chittagong	125343	n.a.	n.a.	3.79	130097
Sylhet	15881	n.a.	n.a.	3.79	16483
Rajshahi	48793	n.a.	n.a.	3.79	50643
Khulna	55231	n.a.	n.a.	3.79	57325
Barisal	7285	n.a.	n.a.	3.79	7561
Bangladesh	**369152**	**383153**	**3.79**	**n.a.**	**n.a.**

Note:

a Estimated for aggregate national level only adding previous year investment with previous year capital stock

b Estimated for the divisions increasing the previous year capital stock by same percentage as the increase national level