

CHAPTER 7

PRODUCTIVITY CHANGE IN THE DIVISIONS

Two techniques have been used in this study to measure the productivity change in the divisions of Bangladesh – non-parametric growth accounting technique and distance functions approach. In the study, the contribution of each factor of production to the output growth has been determined for the divisions from the growth accounting and termed as ‘sources of growth’. Besides, the potential factors constituting the contribution of productivity to the output growth, termed as ‘sources of productivity growth’, have been discussed.

7.1 Sources of Growth in the Divisions

7.1.1 Identifying Sources of Growth for the Divisions

This study conducts two analyses while measuring productivity growth for a particular division. In the main analysis, productivity growth is measured in terms of Malmquist productivity indexes derived by using Data Envelopment Analyses (DEA). Besides, an alternative analysis is conducted using the growth accounting technique with the assumption that the factor income shares for the national level is applicable for all divisions. The measured Malmquist Productivity Indexes for the period from 1984-85 to 1999-2000 is shown in Table 7.1, while a summary of the results of DEA is shown in Table 7.2. The results of the growth accounting approach is presented in Table 7.3, while percentage contribution of each of the factors of production is shown in Table 7.4.

Unlike the analyses at the national level, the analyses at the division level consider only one period – the whole period from 1984-85 to 1999-2000. The reason behind this considering only the whole period for the analysis is the fact that, several special adjustments had to be made on the labor force data for the years 1989-90 and 1995-96. The labor force for the year 1989-90 is not reported for six new divisions but is reported for four greater divisions. There is no way to reach a reliable estimate for

the newer divisions from the data of greater divisions. Besides, the Labor Force Survey (LFS) 1989 is conducted for the calendar year 1989, not the financial year 1989-90. On the other hand, the LFS 1995-96 reports labor force for the divisions for age 15 years and above, while it reports labor force for the national level for age groups 10 years and above and this study also consider labor force as the employed labor aged 10 years and above. So, the age group 10-14 years is missing for the divisions in the year 1995-96 and there is no reliable way of estimating that specific age group for the divisions in 1995-96.

Table 7.1
Data Envelopment Analysis between years 1984-85 and 1999-2000

Division	Efficiency in 84-85 w.r.to 99-00 Frontier (A)	Efficiency in 84-85 w.r.to 99-00 frontier (B)	Efficiency In 99-00 w.r.to 84-85 Frontier (C)	Efficiency In 99-00 w.r.to 99-00 Frontier (D)	MPI ¹ (E)	Catch -up Term (F = D/A)	Boundary -shift Term (G = E/F)
Barisal	100.00	126.29	128.28	100.00	1.008	1.000	1.008
Chittagong	100.00	62.32	185.70	100.00	1.726	1.000	1.726
Dhaka	85.70	57.78	140.31	86.77	1.568	1.012	1.549
Khulna	100.00	90.32	136.43	87.14	1.163	0.871	1.335
Rajshahi	93.25	80.16	119.45	93.73	1.224	1.005	1.218
Sylhet	100.00	90.75	159.67	100.00	1.326	1.000	1.326

Note:

- 1 MPI (Malmquist Productivity Index) is the product of the Catch-up term and the Boundary-shift term. Here, $E = [(C \times D) / (A \times B)]^{1/2}$

However, attempts are made to estimate labor force data for all six divisions with age 10 years and above for the years 1989-90 and 1995-96 as shown in Appendix B. Such attempts has made it possible for this study to conduct analysis for the divisions for all three sub-periods – from 1984-85 to 1989-90, from 1989-90 to 1995-96, and from 1995-96 to 1999-2000. The results of such analyses are presented in Appendix D for curious readers.

Table 7.2
Summary of Results of DEA for the divisions

Division	Catch-up Term	Boundary-shift Term	Malmquist Index
Barisal	1.000	1.008	1.008
Chittagong	1.000	1.726	1.726
Dhaka	1.012	1.549	1.568
Khulna	0.871	1.335	1.163
Rajshahi	1.005	1.218	1.224
Sylhet	1.000	1.326	1.326

Table 7.3
Results of growth accounting for the divisions

Division	Percentage Growth Per Annum				
	GDP	Capital	Land	Labor	TFP
Barisal	6.03	9.36	0.82	4.97	-0.322
Chittagong	6.54	1.71	0.44	1.52	5.071
Dhaka	6.72	5.15	0.17	1.47	3.815
Khulna	6.35	15.71	1.40	1.79	-1.447
Rajshahi	4.84	3.97	0.56	2.20	2.083
Sylhet	6.60	9.23	0.73	1.16	1.981

Table 7.4
Contribution of factors in output growth in the divisions

Division	Percentage Contribution			
	Capital	Land	Labor	TFP
Barisal	67.65	1.76	35.93	-5.34
Chittagong	11.40	0.88	10.15	77.57
Dhaka	33.37	0.33	9.50	56.80
Khulna	107.68	2.84	12.25	-22.77
Rajshahi	35.72	1.48	19.78	43.02
Sylhet	60.91	1.43	7.63	30.03

It can be observed from the results of the analysis presented in Table 7.2, Table 7.3 and Table 7.4 that, Dhaka and Chittagong show highest productivity gain both in the DEA and in growth accounting, while percentages of contribution from TFP are also highest for these two regions. In fact, these two are the most industrialized regions of the country and the largest centers of businesses. The results from these tables, on the other hand, show very low productivity gains for two coastal regions – Khulna and Barisal – in the DEA, while growth accounting shows slight declines in TFP for these two regions. It can be inferred in general from these results that, these two regions were lagging behind from other regions of the country in terms of productivity gain. Contribution of TFP to output growth is also negative for these two regions. This productivity trend for these two coastal regions can be explained by their low level of transport accessibility with other regions of the country (see Alam et al., 2003). Also the road transportation within each of the divisions is hampered by inefficient operation of ferries across the rivers.

It is seen from the results that, while Malmquist productivity index from DEA shows slightly positive productivity for Khulna and Barisal, the growth accounting shows slightly negative TFPG. This difference is due to the fact that, price information is exogenous in growth accounting while corresponding weights for the factors are determined endogenously in DEA. It is notable in this regard that, the price

information for the whole economy was assumed to be applicable for every division. Here, an overestimation of the factor income share going to capital with a corresponding underestimation of the factor income share going to labor may show a negative TFPG in growth accounting, while the productivity growth in DEA would be showing a positive sign.

7.1.2 Sources of Growth for Barisal Division

The results of DEA for Barisal show the catch-up term to be equal to unity for the period. It indicates that, Barisal has maintained the same relative distance from the frontier all the time indicating no change in technical efficiency for this division. The boundary shift term, which is the ratio of TFP in two points in time, has increased only marginally in the period indicating an insignificant amount of gain in TFP in this period. The alternative analysis using growth accounting technique, on the other hand, show a decline in TFP indicating that, Barisal division could not transform the large increase in its labor force and stock of capital into a similar increase in output. Capital has the highest contribution (68%) to output growth in Barisal.

One possible reason for this negative TFPG is the lack of road communication in this coastal region. This region of the country is crisscrossed by many rivers, communication within the region through roadways is highly dependent on ferries, and the main mode of communication from outside the region is water transport. Alam et al. (2003) also finds the development of a major portion of Barisal (Patuakhali region) constrained by lack of transport accessibility.

7.1.3 Sources of Growth for Chittagong Division

Results of the DEA for Chittagong show the catch-up term to be equal to unity indicating that, Chittagong has maintained the same relative distance from the frontier. It indicates indifferent technical efficiency exhibited by this division in the period. The boundary shift term is more than unity in all the sub-periods indicating a constant growth in TFP throughout the period. The results of TFPG calculations using

growth accounting technique also shows positive trend in productivity growth for the period. A very high portion of output growth (78%) in this division comes from TFP.

One possible explanation for this high TFP is the fact that, a very large volume of maritime trading goes through this region due to presence of a very prominent seaport in Chittagong. The output of such trading can be very high in presence of a developed financial sector. Besides, textile and shrimp industries are also promising in this region the TFP of which may be high because of the use of advanced technology in the period.

7.1.4 Sources of Growth for Dhaka Division

The results of the DEA for Dhaka shows the catch-up term to be slightly higher than unity indicating that, the division has moved slightly closer to the frontier in these periods indicating a gain in technical efficiency. The boundary shift term is more than unity indicating a constant growth in TFP in the period. The TFPG calculations using growth accounting technique also shows positive trend in productivity growth. Both capital and TFP has significant contribution to output growth in this division (33% and 57% respectively). This is supported by the fact that, Dhaka is the capital of the country and the main center of all business activities in this small country. Regions like Tongi, Gazipur, Narayanganj and Savar are the major industrial centers of the country.

7.1.5 Sources of Growth for Khulna Division

The results of the DEA for Khulna shows the catch-up term to be slightly lower than unity indicating that, Khulna has moved away from the frontier in these periods indicating reduction in technical efficiency. The boundary shift term is more than unity indicating gain in TFP in the period. The TFPG calculations using growth accounting technique, on the other hand, shows productivity decline. It can be inferred in general from these results that, Khulna is lagging behind from other regions of the country in terms of productivity gain, which may be due to the lack of transport accessibility of a large area of this division from other parts of the country.

7.1.6 Sources of Growth for Rajshahi Division

The results of the DEA for Rajshahi shows the catch-up term to be slightly higher than unity indicating that, Rajshahi has moved closer to the frontier indicating gain in technical efficiency. The boundary shift term is higher than unity indicating an increase in TFP throughout the period. The TFPG calculations using growth accounting technique also shows productivity growth for the period. Both capital and TFP has significant contribution to output growth in this division (36% and 43% respectively). Rajshahi division has good transport accessibility with the center and other regions of the country, which may explain its productivity gain in the period.

7.1.7 Sources of Growth for Sylhet Division

The results of the DEA for Sylhet show the catch-up term to be equal to unity indicating that, Sylhet has kept the same distance from the frontier in this period indicating indifferent technical efficiency. The boundary shift term is higher than unity indicating constant increase in TFP throughout the period. The TFPG calculations using growth accounting technique also shows productivity growth in the period. Capital has the highest contribution to output growth (61%), while TFP has a significant contribution in this division (30%). This indicates an important role of capital in economic growth of Sylhet. In fact, Sylhet is fast becoming the retail capital of Bangladesh, with many shopping centers being built by expatriates to serve fellow expatriates from Britain visiting Sylhet and the emerging middle class. Besides, Sylhet is characterized by its large tea gardens where tea is produced, processed and packaged for export. Tea is one of the major export items of Bangladesh

7.2 Sources of Productivity Growth in the Divisions

7.2.1 Identifying Sources of Productivity Growth for the Divisions

There are many factors which can contribute to the productivity growth of the divisions in Bangladesh. Improvement in quality of labor, improvement in publicly

provided facilities and improvement in transport and communication are noteworthy among many potential sources of productivity growth. During the period under study, all of the divisions experienced improvement in human capital, in education and health infrastructure and in transport and communication sector. Hence, all of these factors may have contributed to the productivity of the divisions in the period under study.

Table 7.5 shows number of primary and secondary schools in different years from 1984-85 to 1999-2000. Number of schools has increased in all of the divisions. This investment in education infrastructure may have been a potential source of productivity growth.

Table 7.5
Number of schools in the divisions

Year	Barisal		Chittagong		Dhaka		Khulna		Rajshahi		Sylhet	
	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.
1984-85	4153	871	8352	1533	11244	2348	5182	1253	11050	2240	3607	404
1989-90	4127	1062	8566	1725	12273	2627	5495	1656	11498	2336	3824	416
1995-96	5940	1107	10614	2125	15980	3387	7668	2042	16918	3665	4563	532
1999-00	6152	1344	11515	2374	16311	3601	8012	2092	16662	4604	5006	625

Note:

Pri. Primary School

Sec. Secondary School

Sources: (i) Thana Education Offices

(ii) District Education Offices, Ministry of Education

(iii) Directorate of Primary Education

(iv) Bangladesh Educational Statistics, BANBEIS, 2003

Table 7.6 shows number of government hospitals and health complexes in different years from 1986-87 to 1999-2000. Volume of medical facilities has increased in all of the divisions. This investment in health infrastructure may also be a potential source of productivity growth.

Table 7.6
Medical facilities in divisions

Year	Barisal		Chittagong		Dhaka		Khulna		Rajshahi		Sylhet	
	Govt	Hlth	Govt	Hlth	Govt	Hlth	Govt	Hlth	Govt	Hlth	Govt	Hlth
	Hos	Com	Hos	Com	Hos	Com	Hos	Com	Hos	Com	Hos	Com
1986-87	6	28	11	66	17	90	10	44	14	98	3	28
1991-92	8	35	16	82	32	105	14	49	23	110	8	31
1995-96	8	35	17	84	33	105	14	49	24	111	9	33
1999-00	8	36	17	83	36	105	14	50	25	111	9	32

Note:

Govt Government

Com Complex

Hos Hospital

Com Complex

Source: Director-General of Health Services (Health Information Unit),
Ministry of Health and Family Welfare

Table 7.7 shows total length of road network in different years from 1986 to 2000. Road length in kilometer is a good indicator of transport infrastructure, which has increased in all of the divisions during this period. This investment in transport infrastructure may also be a potential source of productivity growth.

Table 7.7
Total length of roads in divisions

Survey	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Sylhet	National
Year	Division	Division	division	Division	Division	Division	
1986	637	2440	2734	1452	2776	1139	11178
1992	1426	3015	3236	1592	3122	1236	13627
1994	1561	3576	3823	2050	3452	1206	15668
2000	2308	4935	4991	2720	4533	1312	20799

Source: Roads and Highways Department

Table 7.8 shows number of telephones in different years from 1986 to 2000. Number of telephones is a good indicator of communication infrastructure, which has increased in all of the divisions during this period. This improvement in communication may also be a potential source of productivity growth.

Table 7.8
Number of telephones in greater divisions

Year	Chittagong ^a Division	Dhaka Division	Khulna ^b Division	Rajshahi Division	National
1984-85	36802	83339	17695	13520	151356
1989-90	45870	115620	25450	18560	205500
1995-96	93285	221006	43225	30253	387769
1999-00	110824	347819	71307	49844	579794

Note:

a this former division consist of two later divisions: Chittagong and Sylhet

b this former division consist of two later divisions: Khulna and Barisal

Source: Bangladesh Telegraph and Telephone Board

7.2.2 Sources of Variation of Productivity Growth among Divisions

It can be observed from the results of this study that, divisions showed different performances in terms of productivity change in the periods under study. Differences in pace of improvement of human capital and infrastructures may have contributed to such difference in performances.

Table 7.9 shows literacy rate of the divisions as per 2001 census. Literacy rate for both of Dhaka and Chittagong, the two regions showing highest levels of productivity gain, is higher than the national average. However, the literacy rates for Khulna and Barisal, the two regions showing lowest levels of productivity gain, are even higher. Hence, it can be inferred that, level of literacy has not been the constraint for gaining productivity for these two coastal regions.

Table 7.9
Adult literacy rate as per 2001 Population Census in the divisions

Division	Literacy Rate
Barisal	52.94
Chittagong	46.70
Dhaka	45.84
Khulna	48.17
Rajshahi	40.89
Sylhet	39.55
Bangladesh	45.30

Source: Population Census 2001

Table 7.10 shows number of primary schools in different years for the divisions. Dhaka and Rajshahi have high density of primary schools, while Khulna and Chittagong have low density. However, secondary schools, government colleges, and public universities can also represent education infrastructure.

Table 7.10
Number of primary schools per square kilometer in the divisions^a

Year	Barisal division	Chittagong Division	Dhaka Division	Khulna Division	Rajshahi Division	Sylhet division	National
1984-85	0.312	0.268	0.333	0.233	0.320	0.286	0.295
1989-90	0.310	0.275	0.363	0.247	0.333	0.304	0.310
1995-96	0.447	0.341	0.473	0.344	0.490	0.362	0.418
1999-00	0.463	0.370	0.483	0.360	0.483	0.397	0.431

Note:

a Number of schools reported is divided by the area of the corresponding division

Sources: (i) Thana Education Offices
(ii) Directorate of Primary Education
(iii) Bangladesh Educational Statistics, BANBEIS, 2003

Table 7.11 shows number of health complexes per 1000 square kilometers in the divisions. Rajshahi shows the high density of health complexes, while Khulna shows low density. However, public investment in health infrastructure may have a lagged effect and it is possible that such lagged effect is not captured in the figures representing the time period considered in this study.

Table 7.11
Number of health complexes per 1000 square kilometer in the divisions^a

Year	Barisal Division	Chittagong Division	Dhaka Division	Khulna Division	Rajshahi Division	Sylhet Division	National
1986-87	2.11	2.12	2.67	1.98	2.84	2.22	2.40
1991-92	2.63	2.63	3.11	2.20	3.19	2.46	2.79
1995-96	2.63	2.70	3.11	2.20	3.22	2.62	2.83
1999-00	2.71	2.67	3.11	2.24	3.22	2.54	2.83

Note:

- a Number of facilities reported is divided by the area of the corresponding division multiplied by 1000

Source: Director-General of Health Services (Health Information Unit),
Ministry of Health and Family Welfare

Table 7.12
Length of roads per square kilometer in the divisions^a

Survey Year	Barisal Division	Chittagong Division	Dhaka Division	Khulna Division	Rajshahi Division	Sylhet Division	National
1986	0.048	0.072	0.088	0.065	0.080	0.090	0.076
1992	0.107	0.089	0.104	0.071	0.090	0.098	0.092
1994	0.117	0.106	0.123	0.092	0.100	0.096	0.106
2000	0.174	0.146	0.160	0.122	0.131	0.104	0.141

Note:

- a Road length reported in kilometer is divided by the area of the corresponding division

Source: Roads and Highways Department

Table 7.12 shows length of road network per square kilometer in the divisions. Dhaka, being the center, shows very high density of road network. However, this measure does not inform anything about the connectivity of the regions within a particular division and from the outside. For example, Barisal shows very high density of road network, but this region is least accessible from other parts of the country (see Alam et al., 2003).

Table 7.13 shows number of telephones per square kilometers in the divisions. Dhaka shows the highest density in all the years, while Rajshahi shows the lowest in all the years. Very high score for Dhaka shows the dominance of the center on the other regions of the country in terms of communication facilities.

Table 7.13
Number of telephones per square kilometer in the divisions^c

Year	Chittagong ^a Division	Dhaka Division	Khulna ^b Division	Rajshahi division	National
1984-85	0.79	2.68	0.50	0.39	1.03
1989-90	0.99	3.72	0.72	0.54	1.39
1995-96	2.01	7.10	1.22	0.88	2.63
1999-00	2.39	11.18	2.00	1.44	3.93

Note:

a This former division consist of two later divisions: Chittagong and Sylhet

b This former division consist of two later divisions: Khulna and Barisal

c Number of telephones reported is divided by the area of the corresponding division

Source: Bangladesh Telegraph and Telephone Board

It can be seen from the tables presented in this section that, the effect of the human capital and different types of infrastructure on the productivity gains for the divisions is not straightforward. Other factors like transport accessibility from other regions should be considered while searching for the sources of variation in the productivity gains in the divisions. Unfortunately, this is beyond the scope of this study.