CHAPTER IV
RESULT AND DISCUSSION

4.1 General description of data

Data was complete in the required variables for 805 hospitals. Those hospitals are composed of 25 regional hospitals, 70 general hospitals and 710 community hospitals. The hospitals are distributed over all regions of the country (Central, Northern, North Eastern and Southern).

The three-tier public hospitals are divided into 5 hospital groups or types reflecting the level of complexity of services as follows in table below.

Table 4.1 Structure of public hospitals

Hospital types	Definition	No.
Regional	Regional hospitals	25
Large General	General hospitals with more than 300 beds	51
Small General	General hospitals with 300 beds or less	19
Large Community	Community hospitals with more than 30 beds	257
Small Community	Community hospitals with 30 beds or less	453
Total		805

Descriptive Statistics of input and output variables of interest are presented in Table below.

Table 4.2 Descriptive statistics of output and input variables

Variable	Mean	Standard deviation	Minimum	Maximum
Opv	124743.11	114697.90	12855	821716
Ipvrw	5807.74	11318.40	148	102015
Los	28506.71	51835.90	500	419856
Teach	1.58	5.70	0	58
Bed	89.73	146.00	10	1019
Doctor	10.20	19.50	1	212
Nurse	88.50	129.20	6	1046
Other	70.55	96.70	5	691
Total personnel	174.08	251.60	17	1949
Price of labor	329079.92	69521.76	123873	1277460
Operation cost	138710.36	296828.74	5014	2863912
Price of beds	1201273.22	565503.50	203846	4293116

Tables below show the descriptive statistics of output and input changes before and after universal coverage policy.

Table 4.3 descriptive statistics of overall output and input changes before and after universal coverage policy.

Output and Input	FY 2001	FY 2006	Differences	
			No.	Percentage
Outpatient visit	57,082,808	88,524,921	31,442,113	55.1
Inpatient visit	5,173,335	5,278,941	105,606	2.0
Length of stay	20,642,176	21,577,947	935,771	4.5
Teaching	991	1,262	271	27.3
Beds	64,254	66,596	2,342	3.6
Doctors	4,444	7,587	3,143	70.7
Nurses	56,115	64,645	8,530	15.2
Others	45,298	51,332	6,034	13.3

It is found that the number of outpatient visit be highest increasing output while inpatient visit and length of stay increase a little. For input side, doctors are the most ones, while beds are the least. Although the proportion of increase in total outputs are higher than that in total inputs as shown in tables below, but scale efficiency still increase, thus it is likely to have service burden in the past with low health resources.

The tables below show the descriptive statistics of output and input changes before and after universal coverage policy by hospital types.

Table 4.4 Descriptive statistics of output changes by hospital types.

Hospital types	No.	Outpatient visit		Inpatient visit	
		No.	Percent	No.	Percent
Regional	25	204741.48	62.25	5708.08	14.31
Large General	50	121311.40	62.16	1453.28	6.97
Small General	17	74561.29	73.79	265.94	5.12
Large Community	244	49532.32	64.77	-190.24	.33
Small Community	295	23405.35	53.98	-230.04	.61
Total	631	49829.02	59.66	167.36	1.67

Table 4.4 Descriptive statistics of output changes by hospital types. (cont'd)

Hospital types	No.	Length of stay		Teaching	
		No.	Percent	No.	Percent
Regional	25	34210.48	17.11	6.96	122.37
Large General	50	9931.04	10.44	1.78	69.05
Small General	17	1243.35	7.55	-.06	-2.39
Large Community	244	-8.05	3.02	.04	3.69
Small Community	295	-1475.31	-.91	.00	.00
Total	631	1483.00	2.45	.43	11.68

Table 4.5 Descriptive statistics of input changes by hospital types.

Hospital types	No.	Beds		Doctors	
		No.	Percent	No.	Percent
Regional	25	23.72	4.41	31.76	47.80
Large General	50	5.56	1.92	10.72	42.12
Small General	17	7.18	8.18	7.71	74.27
Large Community	244	4.27	13.76	4.12	196.10
Small Community	295	1.04	13.44	2.29	187.49
Total	631	3.71	12.1	4.98	170.7

Table 4.5 Descriptive statistics of input changes by hospital types. (cont'd)

Hospital types	No.	Nurses		Others	
		No.	Percent	No.	Percent
Regional	25	83.92	15.84	28.96	6.66
Large General	50	40.48	12.98	21.72	8.89
Small General	17	26.47	17.41	14.76	12.39
Large Community	244	8.64	16.29	8.91	20.31
Small Community	295	6.27	22.48	6.10	24.70
Total	631	13.52	18.94	9.56	20.70

4.2 Efficiency result from DEA model

4.2.1 Technical and Scale Efficiency Analysis for Fiscal Year 2006

Overall technical efficiency analysis

The constant returns to scale (CRS) DEA model estimated for the year 2005/2006 indicates average technical efficiency scores of 59%. A summary of the technical efficiency scores is given as table below.

Table 4.6 Overall CRS TE results summary

Statistics	Value
Mean	.590
Standard deviation	.182
Minimum	.202
Maximum	1.000
Total hospitals	805

Only 35 (4.3%) out of 805 hospitals are technically efficient hospitals that were located on the frontier (TE score = 100%). About 16% of all inefficient hospitals have efficiency scores more than 80% and 56% of those have scores less than 60%.

Table 4.7 The overall CRS TE scores by interval

CRS TE scores	No.	Percent
100%	35	4.3
80-99%	78	9.7
60-79%	241	29.9
40-59%	329	40.9
< 40%	122	15.2
Total	805	100

The table below shows the mean CRS technical efficiency scores categorized by hospital types.

Table 4.8 The CRS TE scores by hospital types

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	.758	.140	.499	1.000
Large General	51	.727	.191	.346	1.000
Small General	19	.675	.158	.389	.942

Large Community	257	.603	.160	.280	1.000
Small Community	453	.555	.182	.202	1.000
Total	805	.590	.182	.202	1.000

It is found that the regional and general hospital groups are more technically efficient than community hospital group because community hospital group seldom has the output of teaching. When excluding teaching from the model specification, the mean efficiency score of community hospitals is almost equal to that of regional hospitals and greater than that of general hospitals as table below. It could be assumed that the teaching output have the effects on efficiency score of community hospital group.

Table 4.9 The CRS TE scores with 3 outputs

Hospital types	Mean
Regional	.606
Large General	.527
Small General	.447
Large Community	.602
Small Community	.555
Total	.567

The larger hospitals are more proportionally efficient than smaller ones as table below.

Table 4.10 Technical Efficiency status

Hospital types	Technical Efficiency status		Total
	Efficient	Inefficient	
Regional	3 (12.0%)	22 (88.0%)	25
Large General	6 (11.8%)	45 (88.2%)	51
Small General	0 (0.0%)	19 (100.0%)	19
Large Community	7 (2.7%)	250 (97.3%)	257
Small Community	19 (4.2%)	434 (95.8%)	453
Total	35 (4.3%)	770 (95.7%)	805

Almost (91.9%) regional hospitals and the major portion (74%) of general hospitals have technical efficiency scores more than 60% while about 68% of smaller community hospitals have technical efficiency scores less than 60%.

Table 4.11 CRS TE Scores for technically inefficient hospitals

Hospital type	CRS TE Scores				Total
	< 40%	40-59.9%	60-79.9%	80-99.9%	
Regional	0	2	13	7	22
	(0%)	(9.1%)	(59.1%)	(31.8%)	
Large	2	9	20	14	45
General	(4.4%)	(20.0%)	(44.4%)	(31.1%)	
Small	1	4	10	4	19
General	(5.3%)	(21.1%)	(52.6%)	(21.1%)	
Large	24	115	87	24	250
Community	(9.6%)	(46.0%)	(34.8%)	(9.6%)	
Small	95	199	111	29	434
Community	(21.9%)	(45.9%)	(25.6%)	(6.7%)	
Total	122	329	241	78	770
	(15.8%)	(42.7%)	(31.3%)	(10.1%)	

When changing the output specification from inpatient visit to inpatient visit adjusted with relative weight (RW) of Diagnosis Related Groups (DRG) or from four outputs with teaching to three outputs without teaching, the results of technical efficiency scores were changed accordingly as follows.

In the case of changing from inpatient visit to inpatient visit adjusted with relative weight (RW) of Diagnosis Related Groups (DRG), it is found that the overall mean efficiency scores and differences of efficiency scores among the hospital types decrease but not different in direction. The efficiency scores of larger hospitals decrease in more proportional than that of smaller hospitals as presented in table below.

Table 4.12 The CRS TE scores with adjusted inpatient visit

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	.717	.140	.488	1.000
Large General	51	.698	.189	.326	1.000

Small General	19	.655	.169	.317	.951
Large Community	257	.568	.147	.280	1.000
Small Community	453	.542	.179	.199	1.000
Total	805	.568	.175	.199	1.000

In the case of changing the number of output from 4 outputs including teaching to 3 outputs excluding teaching, it is found that the overall mean efficiency scores decrease but differences of efficiency scores among the hospital types were different in direction as the scores of community hospitals are more than those of general hospitals while that of larger community hospital type almost equal to that of regional hospital type as presented in table below.

Table 4.13 The detailed CRS TE scores with 3 outputs

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	.606	.162	.391	1.000
Large General	51	.527	.157	.284	.982
Small General	19	.447	.144	.269	.750
Large Community	257	.602	.158	.280	1.000
Small Community	453	.555	.182	.202	1.000
Total	805	.567	.174	.202	1.000

By comparison of the efficiency scores from 2 such change using paired sample t-test it is found that these differences are statistically significant (p-value < 0.001 both). These findings are different from the result of previous study of Grosskopf and Valdmanis (1993) that there are no differences when they incorporated the case-mix index.

The CRS technical efficiency scores reveal combined inefficiency that is due to both pure technical inefficiency and scale inefficiency that is due to inappropriate hospital size.

The results further reveal that pure technical inefficiency is more prevalent in small general and community hospital groups. Meanwhile, the scale inefficiency is more in regional and small community hospital groups. It also reveals that large general and small community hospital groups are both pure technical and scale

inefficient but small community hospital group are higher pure technical and scale inefficient.

Table 4.14 CRS, VRS and Scale efficiency scores

Hospital Types	No.	Mean efficiency scores		
		CRS	VRS	Scale
Regional	25	.758	.905	.837
Large General	51	.727	.813	.890
Small General	19	.675	.696	.968
Large Community	257	.603	.626	.965
Small Community	453	.555	.670	.840
Total	805	.590	.673	.886

Pure technical efficiency analysis

The average pure technical efficiency score of all public hospitals is 67.3%. The regional hospitals are more pure technically efficient than general hospitals and general hospitals are more pure technically efficient than community hospitals as table below.

Table 4.15 DEA technical efficiency scores from VRS model

Hospital Types	No.	Pure technical efficiency scores			
		Mean	Std deviation	Minimum	Maximum
Regional	25	.905	.109	.663	1.000
Large General	51	.813	.169	.380	1.000
Small General	19	.696	.157	.389	.942
Large Community	257	.626	.169	.294	1.000
Small Community	453	.670	.197	.333	1.000
Total	805	.673	.193	.294	1.000

There are only 130 (16.1%) out of 805 pure technically efficient hospitals. The regional and general hospitals have higher proportion than community hospitals.

Table 4.16 Status of pure technical efficiency

Hospital Types	Pure technical efficiency		Total
	efficient	Inefficient	
Regional	11 (44.0%)	14 (56.0%)	25
Large General	15 (29.4%)	36 (70.6%)	51
Small General	0 (0%)	19 (100%)	19
Large Community	17 (6.6%)	240 (93.4%)	257
Small Community	87 (19.2%)	366 (80.8%)	453
Total	130 (16.1%)	675 (83.9%)	805

In inefficiency group, 14 (100%) of regional hospitals, 45 out of 55 (81.8%) of general hospitals have pure technical efficiency scores more than 60%. While 339 out of 606 (56%) of community hospitals has pure technical efficiency scores less than 60% as presented in the table below.

Table 4.17 VRS TE Scores for pure technically inefficient hospitals

Hospital type	VRS TE Scores for pure technically inefficient hospitals				Total
	< 40%	40-59.9%	60-79.9%	80-99.9%	
Regional	0 (0%)	0 (0%)	7 (50.0%)	7 (50.0%)	14
Large General	1 (2.8%)	5 (13.9%)	17 (47.2%)	13 (36.1%)	36
Small General	1 (5.3%)	3 (15.8%)	10 (52.6%)	5 (26.3%)	19
Large Community	18 (7.5%)	114 (47.5%)	84 (35.0%)	24 (10.0%)	240
Small Community	12 (3.3%)	195 (53.3%)	134 (36.6%)	25 (6.8%)	366
Total	32 (4.7%)	317 (47.0%)	252 (37.3%)	74 (11.0%)	675

Scale efficiency analysis

Scale efficiency tests indicate that a hospital may be operating at activity levels that are contributing to higher than minimum-average costs (or most productive scale size). This seems to suggest that while on one hand some hospitals may be operating at too large a scale to maximize the productivity of their inputs, other hospitals appear to be too small and therefore exhibiting higher average costs. Further, we are able to furnish the nature of scale inefficiency, i.e. determine whether an individual hospital is operating in an area of increasing or decreasing returns to scale.

The average scale efficiency score of all public hospitals is 88.6%. The regional, large general and small community hospital groups are less scale efficient than medium-sized hospital groups (small general and large community hospital groups). So, the regional, large general and small community hospital groups could have efficiency gains from adjustment of scale of operation.

Table 4.18 Scale efficiency scores

Hospital Types	No.	Scale efficiency scores		
		Mean	Minimum	Maximum
Regional	25	.837	.630	1.000
Large General	51	.890	.602	1.000
Small General	19	.968	.879	1.000
Large Community	257	.965	.752	1.000
Small Community	453	.840	.270	1.000
Total	805	.886	.270	1.000

Our results further show that only 62 (7.7%) out of 805 hospitals were operating at optimal scale, though many others are operating very close to their optimal scale as table below.

Table 4.19 Status of scale efficiency

Hospital Types	Scale efficiency status		Total
	efficient	inefficient	
Regional	3 (12.0%)	22 (88.0%)	25
Large General	9 (17.6%)	42 (82.4%)	51
Small General	3 (15.8%)	16 (84.2%)	19

Large Community	14 (5.4%)	243 (94.6%)	257
Small Community	27 (6.0%)	426 (94.0%)	453
Total	56 (7.0%)	749 (93.0%)	805

It is also found that 144 (19.2%) out of 749 inefficient hospitals could have scale efficiency gains more than 20% in regional, large general and small community hospitals while 46 hospitals could have efficiency gains more than 40% especially in small community hospitals as table below.

Table 4.20 Scale efficiency (SE) scores for scale inefficient hospitals

Hospital types	SE scores for scale inefficient hospitals				Total
	< 40%	40-59.9%	60-79.9%	80-99.9%	
Regional	0 (0%)	0 (0%)	7 (31.8%)	15 (68.2%)	22
Large General	0 (0%)	0 (0%)	10 (23.8%)	32 (76.2%)	42
Small General	0 (0%)	0 (0%)	0 (0%)	16 (100.0%)	16
Large Community	0 (0%)	0 (0%)	2 (0.8%)	241 (99.2%)	243
Small Community	12 (2.8%)	34 (8.0%)	79 (18.5%)	301 (70.7%)	426
Total	12 (1.6%)	34 (4.5%)	98 (13.1%)	605 (80.8%)	749

Pattern of Scale Inefficiency (return to scale)

An additional DEA problem with non-increasing returns to scale (NIRS) is run in order to determine the pattern of scale inefficiency. Interestingly, the pattern of scale inefficiency indicates that decreasing returns to scale is the predominant form of scale inefficiency observed in regional and general hospitals (80-100%) while about 96.2% of small community hospitals were operating on increasing return to scale as table below.

Table 4.21 Pattern of Scale Inefficiency

Hospital types	Pattern of Scale Inefficiency		Total
	DRS	IRS	
Regional	22 (100%)	0 (0.0%)	22
Large General	41 (100%)	0 (0.0%)	41
Small General	12 (80%)	3 (20.0%)	15
Large Community	107 (44.6%)	133 (55.4%)	240
Small Community	16 (3.8%)	409 (96.2%)	425
Total	198 (26.6%)	545 (73.4%)	743

DRS = decreasing return to scale, IRS = increasing return to scale

This suggests that downscaling in hospitals exhibiting decreasing returns to scale and shifting resources towards those facing increasing returns to scale would generally yield efficiency gains.

Input savings

About 41% inefficiency levels are observed. This implies that if the inefficient hospitals were to operate as efficient as their peers on the best-practice frontier, the health system could have reaped efficiency gains amounting to 41% of the total resources used in running the hospitals. The input savings are aggregates for the whole system.

Best-practice hospitals

In DEA, the frontier against which the technical efficiency of all hospitals is measured is defined by those hospitals in the group with a technical efficiency (TE) score of 100%. The hospitals producing on the efficient frontier define the best practice and thus could be regarded as role models. For each inefficient hospital the DEA model has identified efficient hospitals that could be used as comparators. The inefficient hospitals are expected to learn from their efficient peers by observing their production process.

4.2.2 Cost and allocative efficiency analysis

The cost efficiency indicates the proportion of observed cost required to produce the hospital's observed level of outputs and is measured as the ratio of minimized cost to observed cost. The results indicate that the larger hospitals are more cost efficient than smaller hospitals

The average cost efficiency score of all public hospitals is 53.1%. The regional and general hospitals are more cost efficient than community hospitals.

Table 4.22 Cost efficiency scores by levels

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	24	.867	.120	.669	1.000
Large General	46	.671	.132	.365	1.000
Small General	18	.550	.128	.205	.737
Large Community	230	.557	.157	.236	1.000
Small Community	395	.478	.156	.141	1.000
Total	713	.531	.174	.141	1.000

The cost inefficiency may be due to the excessive use of all inputs or the incorrect mix of inputs. That is, cost efficiency has two components: technical efficiency and allocative efficiency. The results revealed that the technical efficiency scores of all public hospitals have the same pattern as cost efficiency scores mentioned above as table below.

The average technical efficiency score of all public hospitals is 56.9%. The regional and general hospitals are more cost efficient than community hospitals.

Table 4.23 Technical efficiency scores by levels of the hospitals

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	24	.899	.116	.683	1.000
Large General	46	.711	.144	.388	1.000
Small General	18	.599	.133	.330	.842
Large Community	230	.593	.166	.257	1.000
Small Community	395	.516	.166	.185	1.000
Total	713	.569	.182	.185	1.000

The other component of cost efficiency is allocative efficiency. The results indicate that allocative efficiency scores in all groups are quite high.

The average allocative efficiency score of all public hospitals is 93.4%. All levels of public hospitals are much highly allocatively efficient at efficiency score more than 90%.

Table 4.24 Allocative efficiency scores by levels of the hospitals

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	24	.963	.038	.849	1.000
Large General	46	.946	.042	.831	1.000
Small General	18	.917	.097	.623	.991
Large Community	230	.942	.054	.679	1.000
Small Community	395	.927	.063	.457	1.000
Total	713	.934	.060	.457	1.000

It might be due to financial pressure in universal coverage policy implementation that affect on allocative efficiency to be high.

In conclusion, cost inefficiency of hospitals is largely due to technical inefficiency. So, improving cost inefficiency needs to improve technical efficiency.

4.2.3 Total Factor Productivity index measurement

For data analysis the Malmquist DEA method is used to identify productivity changes before and after universal coverage policy. The data represented health care performance of year 2001 and 2006 are used as the proxies for performance before and after universal coverage policy. The analysis of two data models was done. The first model is consisted of four outputs with inpatient visit adjusted with relative weight (RW) of DRG (Diagnosis Related Group). That data of only 252 hospitals that composed of those of 89 out of 93 regional and general hospitals and only 163 (22.6%) out of 720 community hospitals are available for analysis. The second one is consisted of four outputs with inpatient visit not adjusted with RW of DRG of 631 hospitals.

Table below shows the results of Malmquist productivity index analysis.

Table 4.25 Malmquist TFP index for two data models

Malmquist TFP index	First model	Second model
Technical efficiency change	1.300	1.319
Technical change	0.647	0.628
Pure technical efficiency change	1.037	1.018
Scale efficiency change	1.253	1.295
Productivity change	0.841	0.828
Number of hospitals	252	631

The results reveal the impact of universal coverage policy implementation on the productivity index. According to second model, it is found that total factor productivity declines by 17.2, technical change decreases by 37.2% and overall technical efficiency change increases by 31.9%. It is also found that technical efficiency increase is largely due to scale efficiency increase.

When considered in details, the results also indicate that TFP change increases in only regional and large general hospitals by 15.4 and 0.4% respectively, but decreases in small general and community hospitals as shown in table below.

Table 4.26 Total factor productivity (TFP) change scores

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	1.154	.285	.822	2.187
Large General	50	1.004	.295	.411	1.669
Small General	17	.803	.215	.311	1.123
Large Community	244	.847	.293	.308	2.092
Small Community	295	.886	.420	.214	4.884
Total	631	.888	.362	.214	4.884

When decomposing of productivity change into technical change and technical efficiency change, it is found that all levels of hospitals decrease in technical change but it affects more on community hospitals regional and general hospitals as shown in table below.

Table 4.27 Technical change scores

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	.927	.115	.679	1.168
Large General	50	.775	.086	.605	1.095
Small General	17	.798	.143	.561	1.236
Large Community	244	.574	.092	.388	.941
Small Community	295	.644	.133	.268	1.207
Total	631	.643	.142	.268	1.236

Decrease in capital investment in the period of universal coverage policy should be taken into account in seeking the causes. It is also found that this situation affects on large hospitals less than small hospitals probably due to better financial status.

The results also reveal that technical efficiency change of all levels of hospitals increase and small hospitals increase more proportionally than general and regional hospitals as shown in table below.

Table 4.28 Overall technical efficiency change scores by hospital type

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	1.265	.341	.814	2.067
Large General	50	1.300	.386	.611	2.240
Small General	17	1.010	.263	.554	1.720
Large Community	244	1.492	.495	.527	3.542
Small Community	295	1.406	.669	.430	7.317
Total	631	1.415	.574	.430	7.317

Tables below showed the results when decomposing of technical efficiency change into pure technical and scale efficiency change.

Table 4.29 Pure technical efficiency change scores by hospital type

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	1.059	.128	.787	1.315
Large General	50	1.081	.261	.549	1.742
Small General	17	.996	.264	.547	1.770
Large Community	244	1.223	.464	.474	2.525

Small Community	295	.992	.394	.477	3.000
Total	631	1.091	.418	.474	3.000

It reveals that pure technical efficiency of all hospital levels change a little bit of 9.1%. Change in large community hospitals is the most by 22.3% increase.

The table below indicates scale efficiency changes. Increase in all hospitals levels is found especially in community hospitals.

Table 4.30 Scale efficiency change scores by hospital type

Hospital types	No.	Mean	Std. Deviation	Minimum	Maximum
Regional	25	1.196	.288	.732	1.869
Large General	50	1.218	.311	.806	2.240
Small General	17	1.016	.077	.831	1.175
Large Community	244	1.270	.272	.836	2.199
Small Community	295	1.469	.585	.619	7.317
Total	631	1.349	.462	.619	7.317

It indicates that overall technical efficiency change is largely due to scale efficiency change.

In conclusion, total factor productivity decrease is attributable to decline in technical change, although there is increase in technical efficiency. However, this phenomenon affects less on regional and general hospitals than community hospitals.

Table below show comparing efficiency measures between 2001 and 2006, it is found that overall technical efficiency have increased in all levels of hospitals as shown in table below.

Table 4.31 CRS, VRS and Scale efficiency scores in year 2001 and 2006

Hospital Types	No.	Efficiency scores 2001			Efficiency scores 2006		
		CRS	VRS	Scale	CRS	VRS	Scale
Regional	24	.658	.862	.765	.826	.919	.899
Large General	49	.611	.788	.779	.769	.829	.927
Small General	16	.741	.777	.955	.745	.757	.985
Large Community	74	.524	.705	.757	.711	.747	.946
Small Community	89	.535	.896	.611	.675	.849	.787
Total	252	.571	.808	.723	.723	.816	.884

When decomposing of overall technical efficiency, it reveals that scale efficiency scores of all levels of hospitals had increased. While pure technical efficiency scores of regional, large general and large community hospitals increase but those of small general and small community decreases. These findings are in line with those mentioned above.

4.3 Result of regression analysis

The results of Tobit regression analysis are given as follows.

Number of observation = 798

LR $chi^2(17)$ = 496.52

Prob > chi^2 = 0.0000

Pseudo R^2 = 0.3107

Log likelihood = -550.6566

Table 4.32 The results of Tobit regression analysis

cte4rc	Coef.	Std. Err.	T	p>|t|	95% Conf. Interval	
					upper	Lower
Bed*	-.0009648	.0004652	-2.07	0.038	-.001878	-.0000516
Ocpr*	-.0116263	.0005806	-20.02	0.000	-.012766	-.0104866
Drugauct	-.0679156	.0534212	-1.27	0.204	-.1727818	.0369506
Region1	-.0731552	.0591302	-1.24	0.216	-.1892282	.0429179
Region2*	-.2503946	.0568312	-4.41	0.000	-.3619547	-.1388346
Region4*	.1457408	.0564165	2.58	0.010	.0349949	.2564868
Htype1*	.5434412	.2667272	2.04	0.042	.0198541	1.067028
Htype2	.2349011	.1604703	1.46	0.144	-.0801032	.5499053
Htype4	.1898029	.138897	1.37	0.172	-.0828527	.4624584
Htype5	.2855607	.1485694	1.92	0.055	-.006082	.5772034
HA1	.0159331	.0628007	0.25	0.800	-.1073451	.1392112
HA2	.0073789	.0667889	0.11	0.912	-.1237281	.138486
HA3	.0091271	.1058957	0.09	0.931	-.1987469	.2170011
Compete	-.0793374	.0669888	-1.18	0.237	-.2108369	.052162
Opvucpc	.0010857	.0027227	0.40	0.690	-.004259	.0064304

Ipvucpc	.0057129	.0066121	0.86	0.388	-.0072667	.0186925
Loscsmpc	-.0076058	.0057917	-1.31	0.189	-.018975	.0037634
_cons	2.775423	.2158142	12.86	0.000	2.351778	3.199067
_se	.4792154	.0123248		(Ancillary parameter)		

Observation summary: 35 left-censored observations at cte4rc <=1
763 uncensored observations

According to the results of Tobit regression analysis, we use total hospital beds in the analysis to capture the effects of hospital size. Technical efficiency and size are found to have positive relationship - large hospitals are relatively more technically efficient than small hospitals as the study results of Ozcan and Luke (1993) indicate that size is consistently related positively to hospital technical efficiency. This may be due in part to the fact that patients are in favor of larger hospitals that offer more advanced technologies or nicer facilities, leaving them with too many inputs available relative to the amount of service they provide. In addition, a small hospital often fails to take full advantage of increasing returns; expansion of its outputs will reduce its unit cost.

We assume that hospitals with greater occupancy rates are likely to have occupancies that approach (or exceed) their committed service capacity and those with lower occupancy rates have occupancies that are less than their committed service capacity. As a result, we expected that the occupancy rate has a positive relationship with technical efficiency. As expected, the results indicate that occupancy rate is positively associated with technical efficiency. The findings of this study are in line with other studies. For example, Chang (1998), in their study the occupancy rate has a positive and significant impact on efficiency. A high occupancy rate results in a high efficiency. Nyman and Bricker (1989) found that if we assume that nursing homes tend to staff for close 100% occupancy rate, then the degree to which the firm's actual occupancy rate is less than this target occupancy rate will have effect on the firm's staffing hours per patient day. As a result, higher occupancy rates would tend to be associated with higher efficiency scores.

Then, we expected that involvement in drug auction is positively associated with technical efficiency. Although the results indicate that no relationship between

involvement of drug auction and technical efficiency, it might be due to the amount of drug auction might not be enough to enhance the technical efficiency because it is still early phase of implementation and there are only 2 out of 19 regions involved. It would be better that the unit of variable measurement might change to the amount of drug auction.

The evidence of location differences in performance across the four regions is found in our analysis because there are statistically significant differences in technical efficiency across the regions. These findings are in line with the study results of Ferrier and Valdmanis (1996). The hospitals in northeastern region are more technically efficient than central region while the southern hospitals are less technically efficient than central ones. Such differences might be expected due to such factors as differences in regulatory environments, demographic characteristics and socioeconomic status.

As known that the regional and larger general hospitals have greater scope of services than smaller general hospitals and would be negatively associated with technical efficiency and the community hospitals have lesser scope of services than general hospitals and might be associated with technical efficiency. The results indicate that only regional hospitals as the most complex scope of services hospitals are negatively associated with technical efficiency. These results correspond to the study results of Chang (1998) that the scope of services is negatively and significantly associated with efficiency.

Hospital accreditation is used as the proxy for hospital quality. We assume that the hospital accredited would be negatively associated with technical efficiency. But the results indicate that hospital accreditation is not associated with technical efficiency. It might be due to hospital accreditation in Thailand not related to a greater use of resources or efficiency reserve of such hospital available for hospital accreditation.

As we assume that public hospitals in the area that compete with the private hospital would be positively associated with technical efficiency. The results indicate that such hospitals are not associated with technical efficiency. It might be due to no incentives to be efficient because in Thailand there are no measures that force the hospital managers to be efficient such as hospital closure in other countries and they believe that it is impossible for the government and policy maker to allow the hospital to go bankrupt.

Lastly we assume that the proportions of universal coverage and civil servant patients are negatively associated with technical efficiency. The results indicate that the proportion of universal coverage patients is negatively associated with technical efficiency, but not statistically different. But the proportion of civil servant patients is positively associated with technical efficiency, but not statistically different. It might be that the number of patients is also positively associated with technical efficiency.