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Are Public Hospitals in Malaysia Efficient? An Application of DEA and Tobit Analysis

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Abstract

The objective of this paper is to examine the efficiency of public hospitals in Malaysia and to identify the factors affecting their performance. We use Data Envelopment Analysis (DEA) to determine the efficiency score and Tobit model to identify the possible determinants of inefficiency. The DEA results show that the average technical and scale efficiencies scores of public hospitals under study are above 90 percent which can be considered as efficient. From the Tobit model, it was found that the daily average number of admissions, the number of outpatients per doctor and hospital classification have influenced hospital inefficiency. Findings from this study may provide useful information for policy makers concerning resource allocation in Malaysian health care system, specifically public hospitals.

Keywords: DEA, hospital performance, scale efficiency, technical efficiency, Tobit model.

JEL classification: I11

1. Introduction

Healthcare delivery systems have been under increasing pressure to improve performance throughout the world. Improving performance in this context means to control health care cost while guaranteeing high quality services and better access to care. In the context of Malaysia, the issue of efficiency in healthcare has been raised in the Eleventh Malaysia Plan (2016-2020) with the intention to enhance efficiency and effectiveness of the health system delivery system. The total health expenditure for Malaysia during 1997-2012 ranged from RM8,286 million (USD 2,959 million) in 1997 to RM42,256 million (USD 13,675 million) in 2012. For the same period, the health spending as a share of Gross Domestic Product (GDP) ranged from 2.94 per cent to 4.49 per cent of GDP. The per capita spending on health was RM626 (USD223) in 1997 and RM1,432 (USD463) in 2012. (MNHA Health Expenditure Report 1997-2012).The upward trend in budget allocation, coupled with high expectations of the population for this service stresses the need to transform the health sector towards a more efficient and effective health system. Hence, costs control and efficient resource allocation in public services are needed.

In Malaysia, public hospitals are classified into five classifications which are district hospitals, district hospitals with specialist, general hospitals, national referral centres and teaching hospitals. The role of public hospitals within the system, is primarily to provide secondary care to the population. In the delivery of healthcare services, the issue of efficiency is very important in determining the optimal level of resources used in producing a given output. Despite being nonprofit-oriented entities, the efficiency of public hospitals needs to be reviewed because it involves costs to the government.

There have been various empirical studies aimed at measuring the efficiency of health care delivery units, particularly hospitals, as a response to the effect of increasing health care costs on government total health expenditures. Most studies found in the literature focused on the efficiency measurement of health care institutions in the United States, Western Europe and some Asia countries. The data envelopment analysis (DEA) technique was the most commonly used method but parametric approaches were also employed. Banker, Conrad and Strauss (1986) made the first attempt to study hospital production using DEA technique by using multiple inputs and outputs.

Since that, many studies have utilized DEA to study hospitals performance, for instance in the US (Mobley & Magnussen, 1998; McDermott & Stock, 2007; Rosko, 2001), UK (Jacob, 2001), and OECD (Spinks & Hollingsworth, 2009; Varabyoya & Schreyögg, 2013; Wang, Chen, & Huang, 2011). A study that has been carried out by Emrouznejad Parker and Tavares (2008) has identified more than 4,000 research articles applying DEA to measure efficiency and productivity published in journals or book chapters. It found that banking, education, health care and hospital efficiency were the most popular application of DEA. Despite of numerous studies on DEA and the clear government views on efficiency agenda of the healthcare sector, to date no study has been undertaken to measure the technical and scale efficiency except for Che Razak (2003), Moshiri, Al-Junid and Mohd Amin (2011) and, Applanaidu, Samsudin, Dash and Chik (2014).

Che Razak (2003) has applied DEA technique in measuring the productivity of government hospitals in Malaysia using six inputs and two outputs and his findings indicate that the average productivity of Malaysian hospitals is 92.62 percent. Moshiri et al. (2011) had analyzed the efficiency of clinical department in three teaching hospitals in Malaysia for the period 1998-2006. Two output variables used, i.e. inpatients discharge and number of out- patient visited. The input variables are number of bed, doctors, nurses and number of non- medical staff. They found that the efficiency score ranges from 0.76 to 0.92. The study by Applanaidu et al. (2014), found that 74 percent of hospitals considered are efficient with average efficiency score above 0.9 or 90 percent.

Unlike previous studies in Malaysia, the efficiency analysis in this study was done separately base on hospitals classification. This is due to the fact that different classification has different objectives and technology, thus cannot be directly compared. Moreover, this study has been extended to the second stage analysis to determine possible factors that may influence the efficiency score estimated by DEA.

The focus of efficiency analysis in this study was on the district hospitals which were divided into two main classifications; specialist and non-specialist and also general hospitals. District hospitals are located in each district of a state where specialist services are offered on special visiting hours. Services provided include outpatient care, inpatient and accident and emergency services (A&E) which covers non-complicated medical cases. In the case of complication, patients will be referred to district hospitals with specialist services or to the general hospitals. District hospitals with specialist services are located in bigger districts. The services offered in these hospitals are more comprehensive as compared to that of district hospitals. These hospitals also serve as referral to district hospitals without specialist. In each state, there is a general hospital which is located at the state capital. This hospital could accommodate a large number of beds and act as a referral to all hospitals in the state. It provides all level of secondary care and some level of tertiary care as some tertiary care are provided at particular hospitals within the region.

The main objective of this study are to examine the efficiency of public hospitals in the northern region of Malaysia which comprise of the Kedah, Perlis, Pulau Pinang and Perak state by estimating the relative technical efficiency (TE) and scale efficiency (SE) and also to determine the main factors that influence the inefficiency of these hospitals. Hence, in this study we used the DEA approach to estimate the TE and SE efficiencies. The Tobit model was used in the second stage to identify factors that possibly affect the inefficiency of the public hospitals in these four states. The study is structured as follows. After the introduction, Section two discusses the research methods that cover the scope and data of the study, the DEA approach and specification of Tobit model. Section three presents the results and analysis while the last section concludes the paper.

2. Research Methods

2.1 Scope and Data of the Study

In this study we focused on efficiency issues of public hospitals in the northern region of Malaysia. Northern region was chosen as the starting point of the analysis and the same procedure can be replicated for all states in Malaysia. Perlis and Kedah represent the less develop states while Pulau

Pinang and Perak have been classified as the develop states. As the operation of hospitals may vary according to its classification (Gannon, 2005; Mc. Killop et al., 1999) the efficiency analysis was done separately based on hospital classification. The division allows us to distinguish the differences in efficiency based on services provided and size. The determination of the number of hospitals, inputs and outputs is very important as it determine the number of degree of freedom of the model. Generally the DEA analysis requires that the number of the data management units (DMUs), in this case are hospitals, to be 3 times greater than the sum of inputs and outputs as suggested by Banker et al. (1989). In this analysis, a minimum of 21 [(3+4)*3] of DMUs are needed for each classification. Therefore, to satisfy this condition, the data for three years are pooled[1] to create a total of 39 DMUs for specialist and 36 DMUs for non-specialist classifications. For pooled data, efficiency scores were estimated based on one common frontier for three years (2008-2010) whereby each hospital at a particular year was treated as a different DMU (Gannon, 2005; Donthu & Yoo,1998; McKillop, Glass, Kerr, & McCallion, 1999; Wolszczak-Derlacz & Parteka, 2011).

The data for DEA analysis consisted of three inputs (number of doctors, nurses and beds) and four outputs (number of inpatients, outpatients, surgeries and deliveries) from 25 public hospitals in the state of Kedah, Perlis, Pulau Pinang and Perak. The combination of input and output used was based on many efficiency studies on hospitals (Gannon, 2005, McKillop et al., 1999; Sahin, Ozcan, & Ozgen, 2011; Zere, McIntyre & Addison, 2001). Data were collected for three years from 2008 to 2010. Due to data constraint five hospitals from Pulau Pinang state were not included in the analysis. For confidentiality reason, the real names of hospitals were not specifically mentioned in the analysis. The three year input-output average distributions by hospital classification are shown in Figures 1 and 2.

As shown in Figure 1, number of doctors, nurses and beds were more in state hospitals compared with other hospitals. As a consequence, in average the total number of doctors in the state hospital was 441, compared with 192 doctors in major specialist hospitals, 70 doctors in specialist hospital and eight minor in non-specialist hospital.

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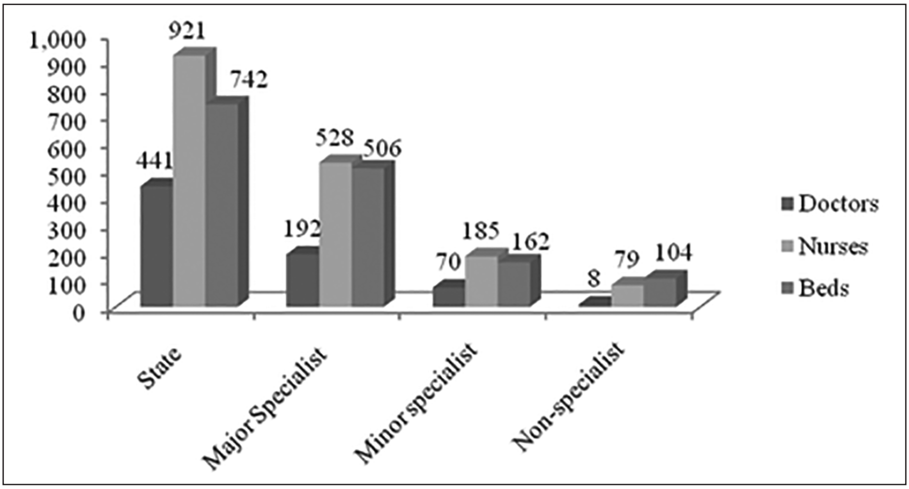
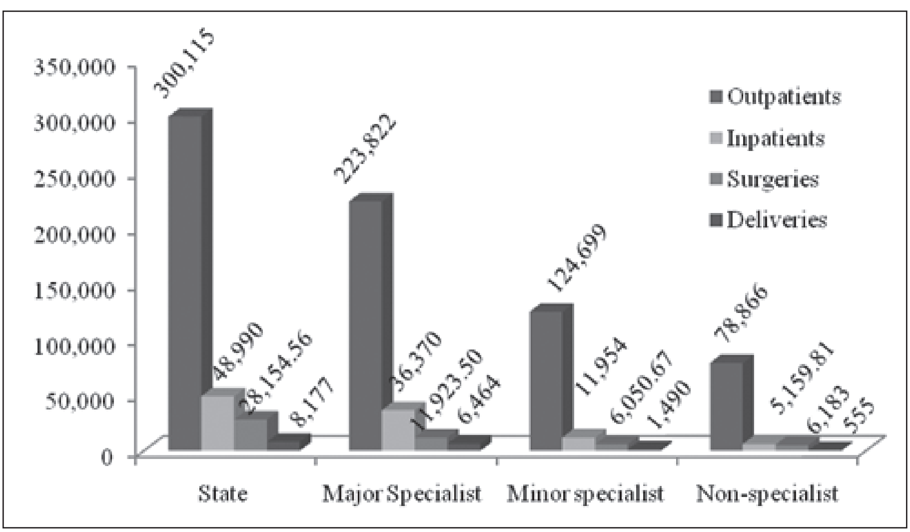
[1] The pooled data are obtained by using the formula of n*number of years where n represents the number of hospitals in each classification.

Figure 1. Three Year Input Average by Hospital Classifications



Similarly, the number of patients treated either outpatients and inpatients were more in state hospitals and major specialist hospital compared with other small hospitals. For example, in the three years from 2008 to 2010, the number of inpatients in a state hospital was 48,990 patients; the major specialist hospital was 36,370 patients, minor specialist 11,954 patients, and non-specialist 5,159 patients as shown in Figure 2.

Figure 2. Three Year Output Average by Hospital Classifications



2.2 Data Envelopment Analysis (DEA)

2.2.1 Technical Efficiency (TE)

The original DEA model was developed by Charnes, Cooper and Rhodes (1978) and referred to as the CCR model, assuming a production technology with constant returns to scales (CRS). Their model implies any proportional change in every input usage would result in the same proportional change in every output. Another model was developed by Banker, Charnes and Cooper (1984) or also known as the BCC model. BCC model is more flexible as it relaxes the assumption of CRS to allow for variable returns to scale (VRTS). In this study we utilized the input oriented DEA that based on BCC model. The input oriented DEA model minimizes inputs while maintaining the current levels of output and environmental factors (refer to Banker et al. (1984) for detail specification). The score from DEA analysis ranges from 0 (not efficient) to 1 (efficient).

2.2.2 Scale Efficiency (SE)

A hospital might experience inefficiency due to its own inefficient operation or being disadvantage due to certain operating environments. By using the CCR and BCC scores, scale efficiency (SE) can be obtained by using the ratio of the two scores as given below:

$$SE = \frac{\theta_{CCR}}{\theta_{BCC}}$$

An efficient DMU that is efficient under CCR and at the same time BCC, will exhibit CRS. For BCC efficient with CRS characteristics (the most productive scale size), its scale efficiency score would be equal to one.

2.3 Tobit Model

2.3.1 Empirical Specification

The result from DEA was extended to the second stage analysis by using econometric model. In this stage, one could determine the factors that may lead to different hospitals' performance. Standard multiple regression that uses ordinary least squares (OLS) assumes a normal and homoscedastic distribution of the disturbance term and dependent variable which is not suitable for limited dependent variable (Maddala, 1983). The expected value of the error term for limited dependent does not comply with the assumption of normality which equals zero. Therefore, a censored Tobit has been used in determining factors that influence inefficiency as the scores by DEA fall between 0 and 1 and mainly clustered at 1. Among studies on hospital efficiency that utilized Tobit model are Zere et al. (2001) and Chilingerian (1995). For computational convenience, we transform the technical efficiency scores in such a way that the censoring point is concentrated at zero (Gillen & Lall, 1997; Greene, 1993; Chilingerian, 1995). The score is transformed by using the formula:

$$y_i = (1/\theta) - 1$$

where y_i is the inefficiencies scores and θ is the technical efficiency scores. With this transformation, hospitals that are fully efficient with the score of 1, are transformed to 0. In the Tobit model, it supposes that there is a latent variable y_i^* that linearly depends on a vector of explanatory variables, x_i and can be written as:

$$y_i^* = \beta x_i + u_i\,,\; u_i \sim N(0, \sigma^2)$$

where u_i is normally distributed error term with mean 0 and variance $\sigma 2$ and β is a vector of unknown parameters.

We observe dependent variable y_i that linking to y_i^* by:

$$y_i = \begin{cases} y_i^* \; if \; y_i^* > 0 \\ 0 \; if \leq 0 \end{cases}$$

The likelihood function of the model is therefore

$$L = \prod_{y_i=0}(1 - F_i)\prod_{y_i>0}\frac{1}{(2\pi\sigma^2)}\text{x}e^{-[1/(2\sigma^2)(y_i-\beta x_i)^2]}\,,\; F_i = \int_{-\infty}^{\beta x_i/\sigma}\frac{1}{(2\pi)^{1/2}}e^{-t^{2/2}}dt$$

Prior to Tobit regression we have tested the existence of multicollinearity, omitted variable bias and misspecification by using STATA 11 on the standard model.

2.3.2 Data and Variables for Tobit Models

The data used in this section is a combination of data from 25 hospitals for three consecutive years (2008-2010), which produced a total number of 75 observations (N = 75). Among explanatory factors that may have been considered in a general model include ownership status, competitiveness, regulatory pressure, demand patterns, patient characteristics, provider practice, organizational setting, managerial practices, and illness characteristics (Cooper, Seiford & Zhu 2011: p.473). We concentrated on demand pattern (*bedrate, adm, stay, turnover*), distribution of resources (*DocNurse, DocOP, DocIP*), and organizational setting (*specialist*). The possible exploratory variables used in the model are explained in Table 1, together with their summary statistics.

Table 1: Dependent and Exploratory Variable

Variable	**Definition**	**Mean**	**Std. Dev**	**Min**	**Max**
score	Transformed inefficiency score	0.052	0.094	0	0.408
bedrate	Bed occupancy rate (%)	52.805	16.904	24.140	90
adm	Daily average number of admission	47.432	46.843	9.120	169
stay	Mean length of stay (days)	2.909	0.619	1.870	4.560
turnover	Turnover interval for beds (days)	2.876	1.537	0.400	7.480
DocNurse	Number of nurse per doctor	8.127	6.964	1.041	37
DocOP	Number of outpatient (‘000) per doctor	6.850	6.003	0.576	0.272
DocIP	Number of inpatient (‘000) per doctor	0.577	0.440	0.054	2.264
specialist	1 if specialist hospital, 0 otherwise	0.520	0.503	0	1

3. Results and Analysis

3.1 Technical and Scale Efficiency of Hospitals with Specialist

Table 2 shows the variable return to scale technical efficiency (VRTSE) or the technical efficiency scores and scale efficiency (SE) scores for hospitals with specialists for the years 2008 to 2010. A hospital is scale-efficient if the score is 1 and as such is said to operate under constant returns to scale. Technical efficiency scores also indicate the overall extent how to reduce inputs in order to attain 100 per cent efficiency for the inefficient units. The hospitals producing on the efficient frontier define the best practice and thus could be regarded as role models. Inappropriate size of a hospital (too large or too small) may sometimes be a cause for technical inefficiency. This is referred as scale inefficiency and takes two forms which are decreasing returns to scale (DRS) and increasing returns to scale (IRS) (Seiford & Zhu, 1999).

In 2008, all hospitals were found to be technically efficient, except two – AE and AF. But, in 2009 and 2010, the numbers of inefficient hospitals have increased to three and seven hospitals respectively. The average technical efficiency scores of all hospitals for the respective year are 0.990 (2008), 0.962 (2009) and 0.949 (2010), and the three-year average score is 0.967. Hospital AE is not efficient in all years considered. Based on its scores, it implies that AE could have reduced its inputs to 17% in year 2009 and 2010 while maintaining the same number of outputs. Beside AE, the other two hospitals which were found to be inefficient in year 2009 and again in 2010 were RA and AB. The efficiency score for RA was 0.813 in year 2009 but decreased to 0.728 in 2010. These findings suggest that hospital RA could have had a maximum of 19% and 27% reduction of its input in year 2009 and 2010 respectively while maintaining the same output level in the mentioned years.

In terms of scale efficiency, the average scale efficiencies of all hospitals were 0.941 in 2008 and 2009, and 0.933 for year 2010 which indicate that average operation inefficiency was respectively 5.9 percent (2008 and 2009) and 6.7 percent (2010). In year 2008, five hospitals (38%) had a scale efficiency of 1, which implies that they had the most productive size for that particular input-output mix. Thus, 62% of the remaining considered hospitals were scale-inefficient in the year 2008. In year 2009 the number of scale-inefficient hospitals remained the same as in year 2008 but increased to 69% in 2010. Scale efficiency shows the efficiency of a DMU based on its operation size. It shows that some hospitals were technically efficient (based on VRTS scores) but not scale-efficient. Within scale efficiency analysis, three out of eight scale-inefficient hospitals showed that they were operating under increasing returns to scale (IRS) in year 2008, meaning that the hospitals could have improved their efficiency levels if they had increased inputs. Conversely, five out of eight hospitals were shown to be operating under decreasing returns to scale (DRS) in the same year, which reflects the size of the hospitals is large for the volume of its operation (The percentage increase in the outputs is smaller than that of inputs). In year 2009 only two of the eight scale-inefficient hospitals experienced IRS, while six hospitals manifested DRS. In year 2010, there are 9 hospitals with scale-inefficient and from this number three manifested IRS while six DRS.

Out of thirteen hospitals, 46% of the specialists' hospitals have DRS, which means they were using more inputs (or have at their disposal) as compared to the level of output that they need to produce, or inputs underutilization. Given that the outputs are beyond the control of the hospitals and the critical nature of hospital service to the population, the relatively 'excess' input might be in order to maintain some level of 'readiness' based on the size of hospitals and population in the districts. Since these hospitals cannot increase the outputs, i.e. to look for more patients, input minimization might be the best way.

3.2 Technical and Scale Efficiency of Hospitals without Specialists

Table 3 shows the technical efficiency (VRTSE) scores and scale efficiency (SE) scores for hospitals without specialists. Similar to the analysis for hospitals with specialists, the performance of these 36 DMUs is based on one common frontier for the three years. Overall, there were 19 efficient DMUs over considered years. Table 3 displays the scores by year for easy interpretation.

In 2008, six hospitals were technically efficient with overall efficiency average of 0.973. There were six inefficient hospitals with average of 0.946. In 2009, the number of efficient hospitals has increased to eight but the overall average score remain the same. The average efficiency score for seven inefficient hospitals has declined to 0.918 and further declined to 0.890 in 2010. Of 12 hospitals, it shows that three (KH, KI, AL) were efficient in all three years while two hospitals (KF, AM) were consistently inefficient. The three-year average efficiency score for hospitals without specialist was 0.960.

In year 2008, five hospitals had a scale efficiency of 1 with overall average of 0.951. Of seven scale-inefficient hospitals, five hospitals had decreasing return to scale (DRS) while two exhibited increasing returns to scale (IRS). The number of scale-efficient hospitals has increased to six in 2009 but fall again to five in 2010. On average, the scale efficiency scores (both overall and inefficient hospitals average) in 2008 were the highest of the three years.

From DEA analysis it was found that the technical and scale efficiency scores for both classifications have decreased in 2010 when compared to 2008. This implies that in 2010, in general, the hospitals used more inputs than in 2008 for the same combination of outputs. The next section discusses the second stage analysis that utilizes Tobit model to identify the possible determinants of inefficiency.

Table 2: Technical and Scale Efficiency of Hospitals with Specialists, 2008-2010

	Efficiency -2008			Efficiency -2009			Efficiency -2010		
DMU	**VRSTE**	**SE**	**Return to Scale**	**VRSTE**	**SE**	**Return to Scale**	**VRSTE**	**SE**	**Return to Scale**
KA	1	0.857	DRS	1	0.883	DRS	1	0.886	DRS
KB	1	0.984	DRS	1	0.973	DRS	0.986	0.924	DRS
KC	1	1	CRS	1	1	CRS	0.977	0.999	IRS
KD	1	0.988	IRS	1	1	CRS	1	1	CRS
RA	1	1	CRS	0.813	0.97	DRS	0.728	0.986	DRS
AA	1	0.667	DRS	1	0.628	DRS	1	0.573	DRS
AB	1	0.851	DRS	0.860	0.896	DRS	0.844	0.878	DRS
AC	1	0.953	DRS	1	0.988	DRS	0.988	0.971	DRS
AD	1	1	CRS	1	1	CRS	1	1	CRS
AE	0.939	0.966	IRS	0.827	0.938	IRS	0.828	0.919	IRS
AF	0.925	0.970	IRS	1	1	CRS	1	1	CRS
AG	1	1	CRS	1	0.956	IRS	1	1	CRS
PA	1	1	CRS	1	1	CRS	0.982	0.999	IRS
No. of Efficient Hospitals	11	5		10	5		6	4	
Average score (overall)	0.990	0.941		0.962	0.941		0.949	0.933	
Average score (inefficient hospitals)	0.932	0.905		0.833	0.904		0.905	0.904	

Table 3: Technical and Scale Efficiency of Hospitals without Specialists, 2008-2010

	Efficiency -2008			Efficiency -2009			Efficiency -2010		
DMU	**VRSTE**	**SE**	**Return to Scale**	**VRSTE**	**SE**	**Return to Scale**	**VRSTE**	**SE**	**Return to Scale**
KE	0.991	0.997	DRS	1	1	CRS	0.991	0.989	DRS
KF	0.857	0.991	IRS	0.850	0.996	IRS	0.726	0.999	IRS
KG	1	1	CRS	1	1	CRS	0.932	0.999	DRS
KH	1	1	CRS	1	1	CRS	1	1	CRS
KI	1	1	CRS	1	1	CRS	1	0.936	IRS
AH	0.967	0.985	DRS	1	1	CRS	0.936	0.999	IRS
AI	1	1	CRS	0.999	0.981	IRS	1	0.995	IRS
AJ	0.973	0.997	IRS	1	1	CRS	0.874	0.997	IRS
AK	1	0.850	IRS	0.974	0.819	IRS	0.958	0.642	IRS
AL	1	1	CRS	1	0.958	IRS	1	0.812	IRS
AM	0.921	0.936	IRS	0.850	0.898	IRS	0.816	0.836	IRS
AN	0.967	0.653	IRS	1	0.691	IRS	1	0.689	IRS
No. of Efficient Hospitals	6	5		8	6		5	1	
Average score (overall)	0.973	0.951		0.973	0.945		0.936	0.908	
Average score (inefficient hospitals)	0.946	0.916		0.918	0.891		0.890	0.899	

3.3 Tobit Model

In developing the model, we begin by including every possible variable as described in Table 1 one at a time to see the effect. We continuously refined the model until we came to the final model as reported in Table 4. In the final model, we dropped bed occupancy rate (*bedrate*), mean length of stay (*stay*), turnover interval for beds (*turnover*) and number of inpatient per doctor (*DocIP*).

The values of Variance Inflation Factors (VIF) are found to be ranged from 1.92 to 3.22 with the mean value of 2.41. Given that the value is less than 10, the estimated model does not suffer from serious multicollinearity problem. The likelihood ratio test is conducted by calculating the log-likelihood statistics given by -2 log(λ), where log λ represents the difference between the log of maximized values of the likelihood function when all dependent variables equal to zero and the values of similar maximization when dependent variables are as observed in the regression. The model chi-square, with four degree of freedom is 16.67 and it shows that the model is statistically significant at 1% level. The omitted variables test by using Ramsey RESET test also suggests that the model has no omitted variables bias. We have checked whether the model is correctly specified by running a regression with the observed *score* against *score-hat* (predicted *score)* and *score-hat squared* as control variables. The insignificant power of the square of predicted *score* suggests that the independent variables are correctly specified.

Table 4 shows that the daily average number of admission (*adm*), number of outpatients per doctor (*DocOP*), and type of hospitals (*specialist*) are significant in determining inefficiency and with the expected signs. For one unit increase in *adm*, there is a 0.0017 point decrease in the predicted value inefficiency score (*score*). This means that an increase in daily average number of admission would reduce inefficiency. It shows that the number of outpatient (in thousands) per doctor, *DocOP*,has negative relationship with *score* whereby a thousand unit increases in outpatient per doctor would drop the predicted value of *score* by 0.0215 units. Both *adm* and *DocOP* are related to hospitals' output, indicating that the growth of output may increase relative efficiency of a hospital. The predicted value of specialist hospitals, *specialist*, is 0.1032 lower than the non-specialist which suggests that the former relative efficiency score is higher than the latter. Service characteristics also play a significant role in Chilingerian (1995).

Table 4: Estimation Result for Tobit Model

score **(inefficiency)**	**Coefficient**	**Std. Dev**	**P>t**
adm	-0.0017	0.0007	0.021**
DocNurse	-0.0014	0.0062	0.825
DocOP	-0.0215	.00768	0.007***
specialist	-0.1032	0.0615	0.098*
_cons	0.2547	0.0780	0.002***
Sigma	0.1530	0.0207	
LogLikelihood	-6.613		
LR chi2(4)	16.67		(p<0.01)
Ramsey RESET Test			0.728

The symbols ***, **, and * denote 1, 5 and 10% level of significance, respectively.

4. Conclusion

The present study analyzed the technical and scale efficiency of 25 hospitals in the northern region of Malaysia. The findings suggest that the technical efficiency level for both types of hospitals – with specialists and without specialists can be considered as high with an average of 90% efficiency levels. The DEA analysis was extended for identifying environmental factors that may affect inefficiency using Tobit model. It is found that admission rate, number of outpatient per doctor and types of hospitals have significant influence on efficiency. As for scale efficiency, an increasing number of specialist hospitals are showing DRS whereas increasing number of non-specialist hospitals show IRS. Hence, relatively, specialist hospitals are using more inputs (or have at their disposal) as compared to the level of output that they need to produce, or inputs underutilization as compared to the non-specialist hospitals. One possible explanation for this is accessibility, i.e. in terms of location and type of illness.

Comparatively, hospitals with specialist are located farther, e.g. in state capitals and also caters for more serious illness and act as referral hospitals. But for common illness, primary care and secondary care people can get services at the hospitals without specialists. Moreover, the drive towards better service and quality care have lead the government to strengthen and develop more specialist and subspecialists services in more public hospitals. In terms of policy implication, among the initiatives that can be made by the government to enhance public health service delivery and coverage is to ensure optimal use of scarce resources by channeling them to the most needed hospitals based on demand.

There are some limitations to the study. First, efficiency approach by DEA measures the ratio of outputs to inputs. Ideally, the measurement of outputs should include quality, but due to data limitation no measure or information on quality is included. Second, the study only focuses on public hospitals and therefore comparison on the level of efficiency between public and private hospitals is not being analyzed.

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